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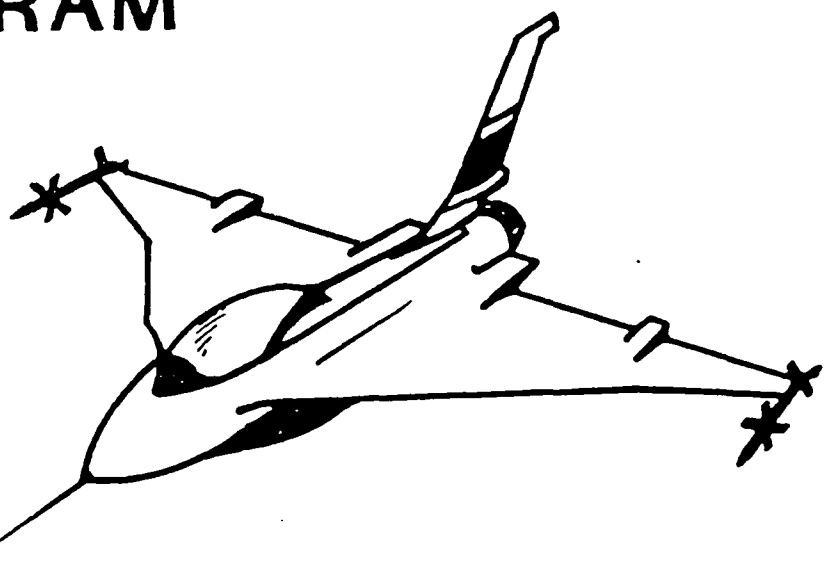

PHASE 3 PROPOSAL
CATEGORY 1 PROJECT
MACHINE SHOP IMPROVEMENTS

OCTOBER 26, 1984

(REVISION - A)

INDUSTRIAL
TECHNOLOGY MODERNIZATION
PROGRAM

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This project will minimize space between work areas for product throughput and minimize material handling.

This project will include the procurement of specific equipment and tools, improve machining methods and improve the facility layout. The functional improvements will be in the machine shop, sheet metal shop and welding shop.

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PHASE III PROPOSAL
CATEGORY 1 PROJECT
MACHINE SHOP IMPROVEMENTS
TRACOR PROPOSAL - 153-0087A

OCTOBER 26, 1984

SUBMITTED TO:

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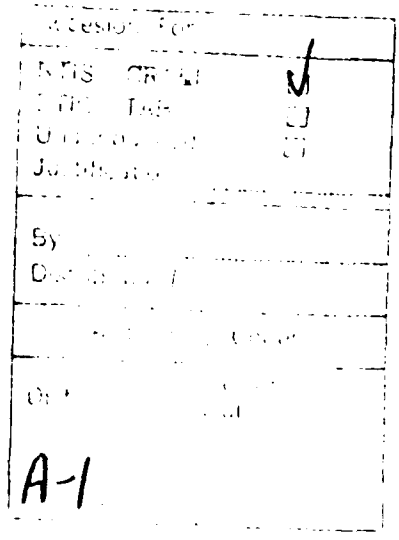

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MACHINE SHOP IMPROVEMENTS

1.0 INTRODUCTION

This Phase III proposal is the result of the successful completion of Pnase II of the Machine Shop Improvement Project. This project was chosen in Phase I as an attractive opportunity for productivity improvements. Phase II identified moderate cost savings in production through modernization improvements. Cost benefit analysis for the project was based on the aggregate of the proposal improvements.

1.1 Machine Shop Description

The area referred to as the Machine Shop consists of seven different shops and associated areas. They are:

- Machine Shop
- Tool Crib
- Sheet Metal Shop
- Raw Stock Storage Area
- Weld Shop
- Mold Shop
- Tool and Model Shop

All of the above areas are located in Building 2, which is shown on the map in Figure 1-1. The actual layout of the areas is shown in Figure 1-3. The seven areas together occupy a total of 17,370 square feet in Building 2, which represents 38% of the total main floor capacity of that building. The square footage and manning of each shop is shown in Figure 1-2.

Functionally the Machine Shop areas fall under the Primary Manufacturing Directorate and produces machined, sheet metal, welded and molded parts used in the assembly of contracted units and systems. Seven (7) machines are Numerically-Controlled (N.C.), 26 are not. Production operators assigned to the N.C. Machines are provided with specific instructions which

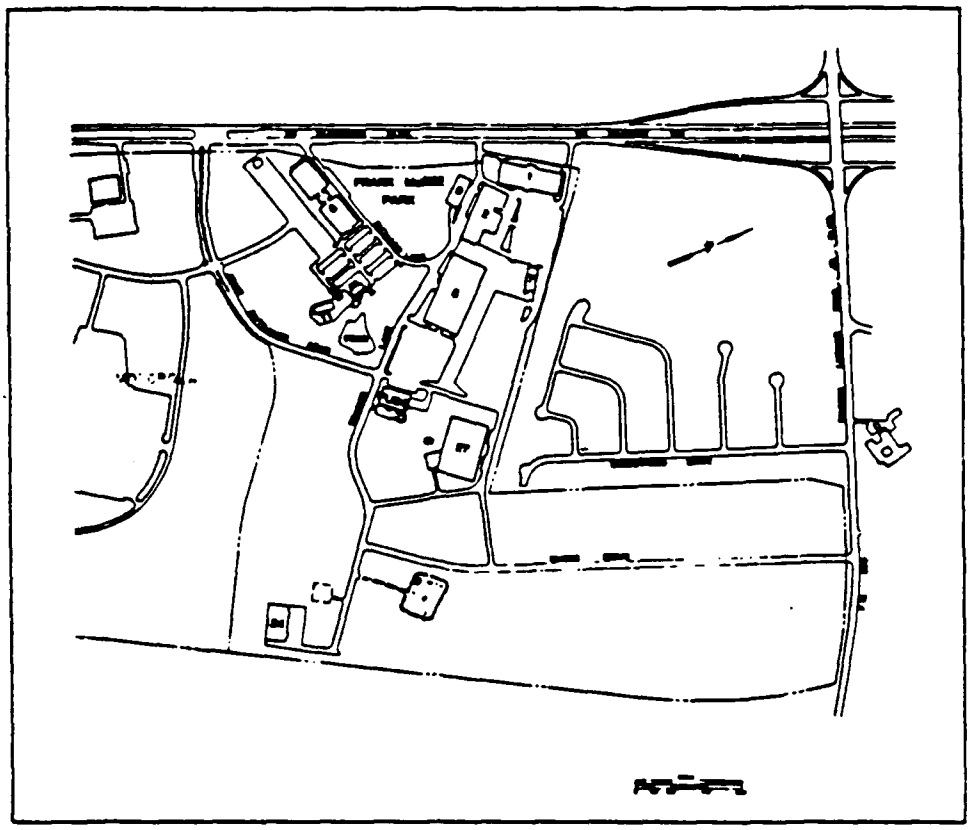


Figure 1-1. MAP OF TRACOR AREA

SHOP/AREA	SQUARE FOOTAGE	MANNING/SUPERVISORS
Machine Shop	4,072	32/1
Tool Crib	590	1
Sheet Metal Shop	7,065	14/1
Raw Stock Storage Area	940	1
Weld Shop	537	3
Mold Shop	620	1
Tool and Model Shop	3,546	13/1
TOTAL	17,370	65/3

Figure 1-2. AREA AND MANNING BY SHOP

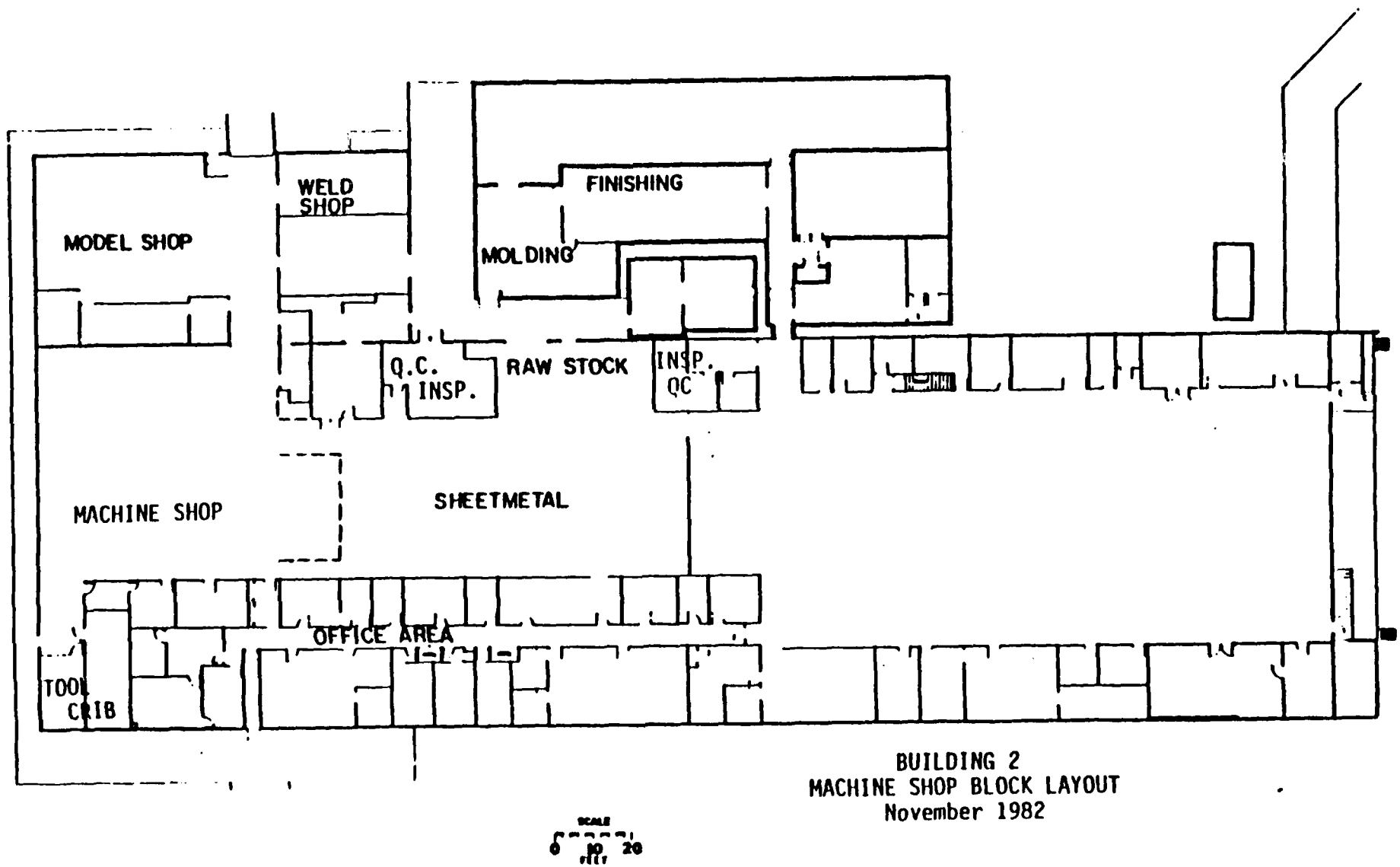


Figure 1-3. BUILDING 2 LAYOUT

identify all necessary fixtures, tools, and the location of tools in the holding magazines. All other operations require the individual to use his knowledge and skills, in addition to the use of drawings and process instructions, to accomplish the set-ups. The production operators move completed parts at their work station to the next work station within their shop or department. Material handlers move parts and assemblies to other departments.

Parts or assemblies requiring in-process or end-of-operation inspection are transported to an inspection station. After inspection approval, they are transported to the next fabrication, assembly or finishing operation.

1.2 AS IS Assessment

1.2.1 Machine Shop - AS IS - The Machine Shop performs machining operations to a myriad of aluminum and stainless steel parts which are produced for the assembly departments. It occupies 4072 square feet and is currently staffed with thirty-two (32) production workers and one (1) supervisor.

The equipment layout, shown in Figure 1-4, is limited by space and is crowded with tool storage cabinets, material handling carts, small belt grinders and portable drill presses. Figures 1-5 and 1-6 show photos of the shop.

The workload is primarily milling and drilling of flat aluminum plates, aluminum castings, and small diameter cylindrical parts. Normally, lots range from 15 to 300 parts, requiring two (2) to four (4) weeks for work completion.

Most machines are manually controlled mills, lathes, drill presses and tapping heads. One (1) Mazak lathe and five (5) small mills are equipped with numerical controls (N.C.). A listing of capital equipment is provided in Figure 1-7.

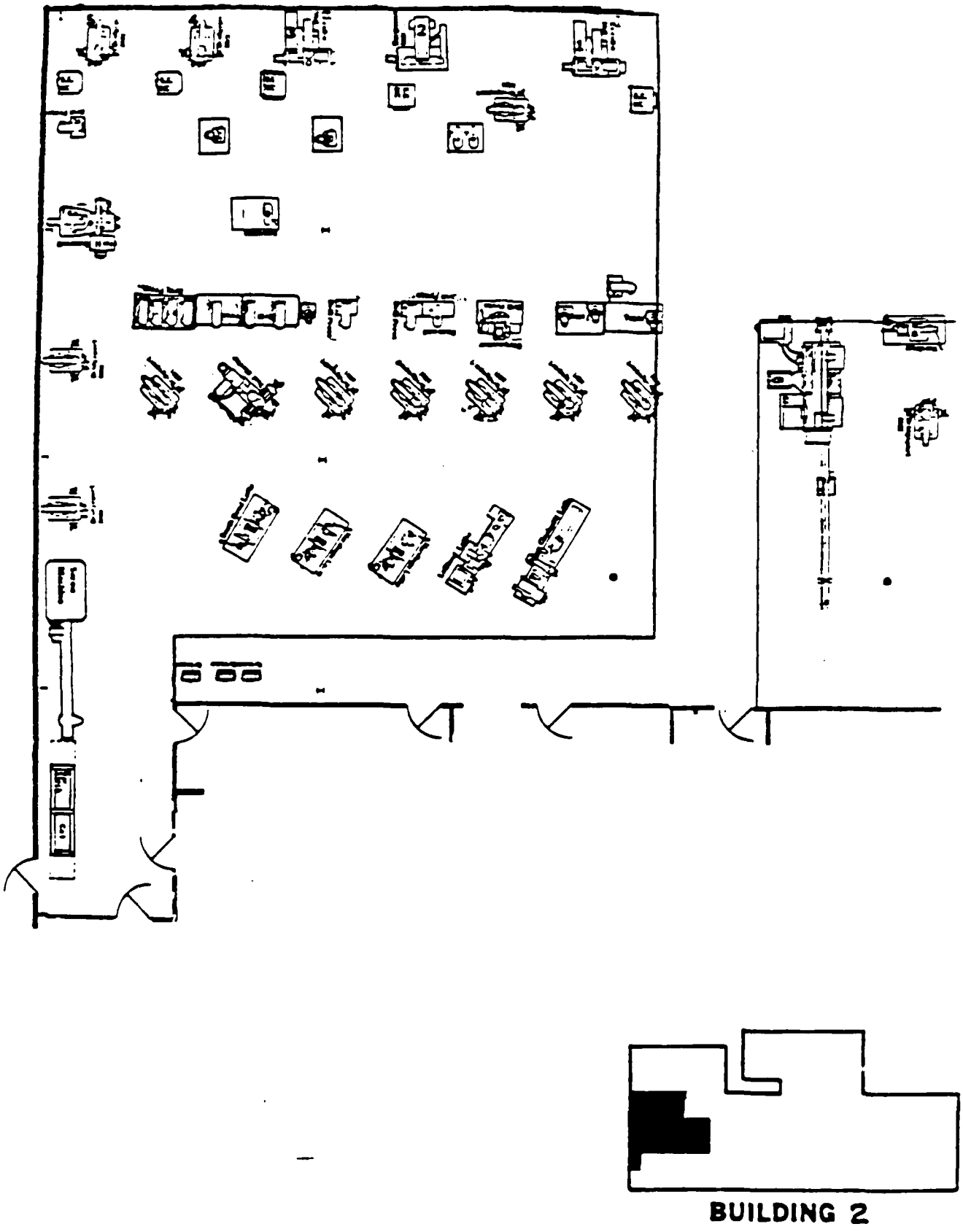


Figure 1-4. MACHINE SHOP LAYOUT

FIGURE 1-6. MACHINE SHOP

MACHINE	QTY	YEAR OF PURCHASE	CONDITION
N. C. Bridgeport Mill Model 2J, 1½ H.P.	2	1970	Poor
N. C. Excello Mill Model 3, 24 Tool Station, 1½ H.P.	2	1976 1978	Fair
N. C. Burgmaster Mill Model 2BL, Variable H.P. (3, 2, 1, 5)	1	1975	Poor
Bridgeport Mill Model 36306, Multi Speed 1 H.P.	6	1964-1971	Poor
Bridgeport Mill Model 25, 1½ H.P.	2	1975	Good
Bridgeport Mill Series I	2	1977	Good
Cincinnati Mill 2 H.P. Power Fd.	1	1970	Fair
N. C. Mazak Lathe Slant Turn I5 Variable H.P.	1	1981	Good
Hardinge Lathe Model DMS-59, 5" Swing, 1.0" Bar, 1 H.P.	3	1969	Fair
Cincinnati Lathe Model 2669X 357, 12" Swing, 3 H.P.	1	1970	Fair
LeBlond Lathe Model 40463-DXD, 16" Swing, 5 H.P.	1	1970	Fair
Burgmaster Drill Press, Model 0B-8391	5	1967-1978	Poor
Cincinnati Commander Hd. Dr. Press Model 16-3000	1	1963	Fair
Powermatic Commander Hd. Dr. Press Model 1200	1	1967	Fair
Buffalo Commander Hd. Dr. Press Model 20	1	1967	Fair
Cincinnati Gang Drill Press Model 16, 4 Position	1	1963	Poor
Walker-Turner Gang Drill Press Model 65-0003 Position	1	1963	Poor

Figure 1-7. MACHINE SHOP CAPITAL EQUIPMENT

1.2.2 Tool Crib - AS IS - The Tool Crib, shown by layout in Figure 1-8 and a photo in Figure 1-9, is used for the storage and maintenance of fixtures, cutting tools, holding devices and shop supplies used by the Machine Shop personnel. It is controlled by one (1) tool crib clerk who maintains records of everything checked in and out of the crib by the machining personnel. It occupies 590 square feet.

The current racks and cabinets used for storage of cutting tools and shop supplies does not allow proper organization in the overcrowded crib. This creates delays on the part of machine shop personnel.

1.2.3 Sheet Metal Shop - AS IS - In addition to performing all the sheet metal fabrication and assembly work, this shop does all of the required manual deburring operations and raw stock sawing operations for itself and the Machine Shop. The shop occupies approximately 7,065 square feet and is shown in the equipment layout, Figure 1-10, and photograph, Figure 1-11. It is staffed with fourteen (14) production workers and one (1) supervisor.

The capital equipment, listed in Figure 1-12, is poorly arranged for proper work flow and is crowded with work benches, portable drill presses, belt sanders, and material handling carts. With the exception of one (1) N.C. Di-Acro Punch Press, the machines and tools are manually operated cut off saws, shears, punch presses, notchers, press brakes, nibblers, rollers, drill presses, belt sanders, and rivet machines.

Most punched parts are produced on the N.C. Di-Acro Punch Press. The parts are punched in multiples from one (1) sheet and are broken apart after deburring on the Time Saver. Low volume parts are punched on one of the two Strippit Turret Presses. Bending operations take place on oversized press brakes not suitable for close tolerances, causing bend adjustments for parts requiring welding. The sub-assembly work includes riveting, installation of clinch nut, threaded inserts and helicoils. Lots normally range from 30 to 300 parts for operations in the sheet metal shop.

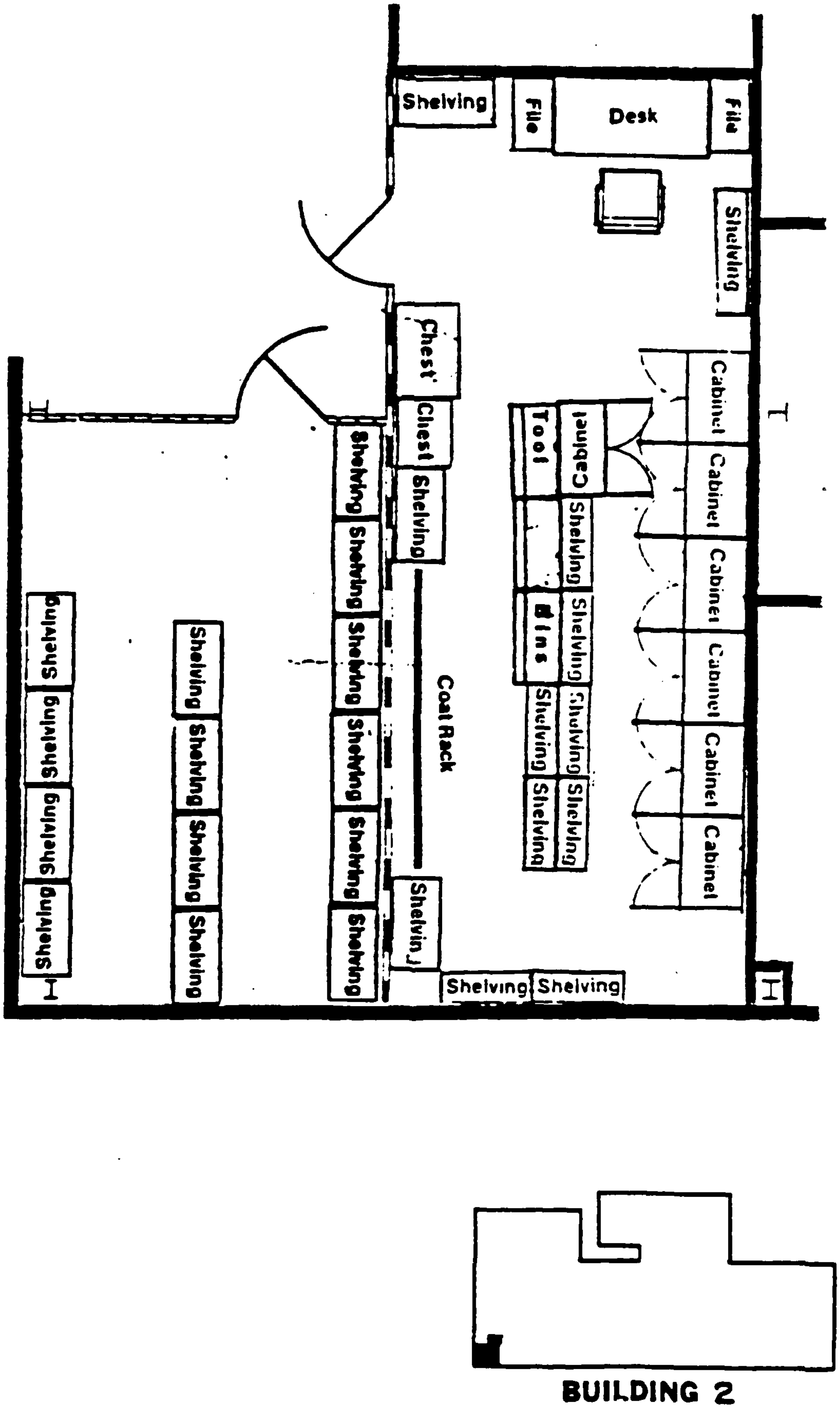


Figure 1-8. TOOL CRIB LAYOUT

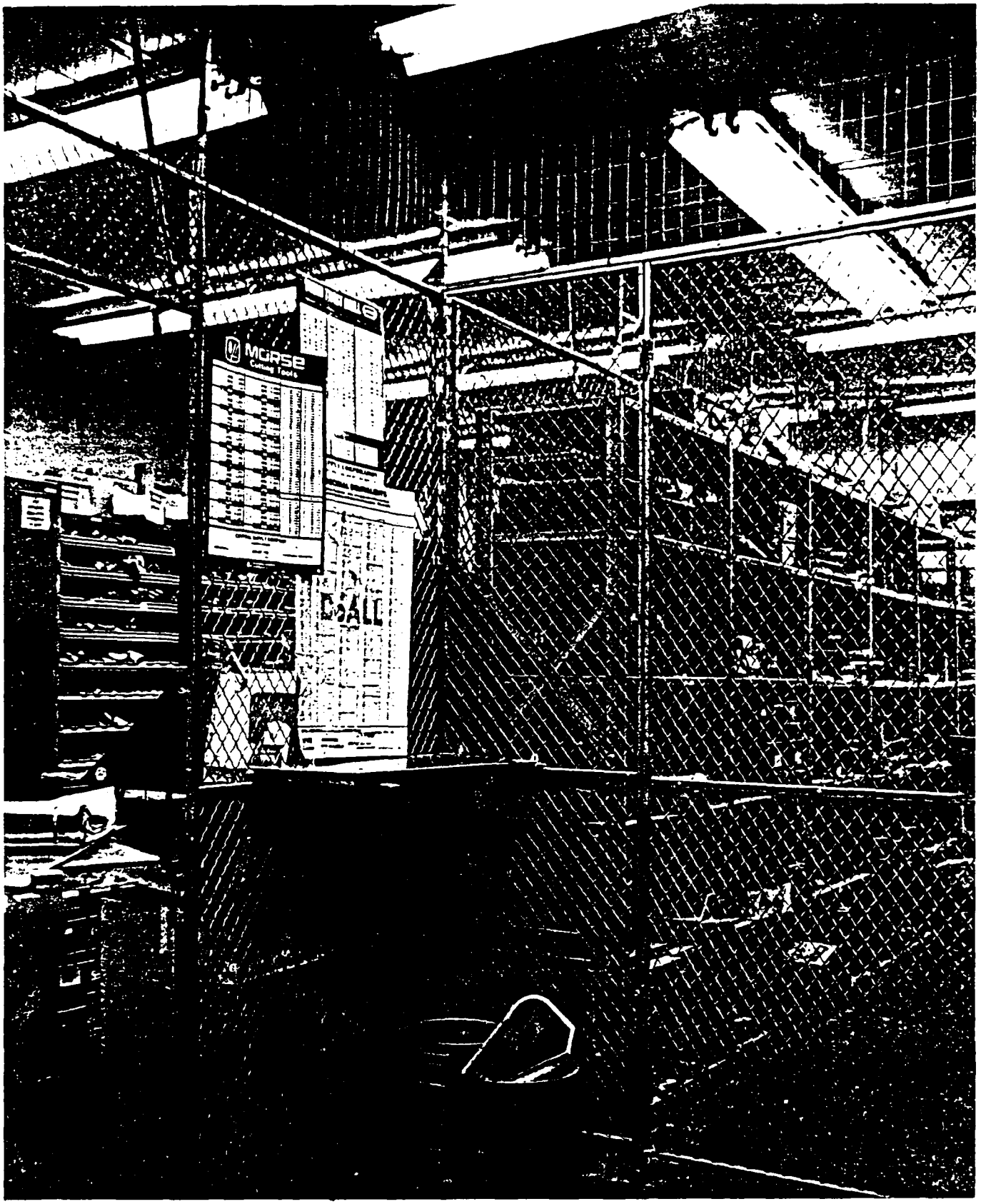
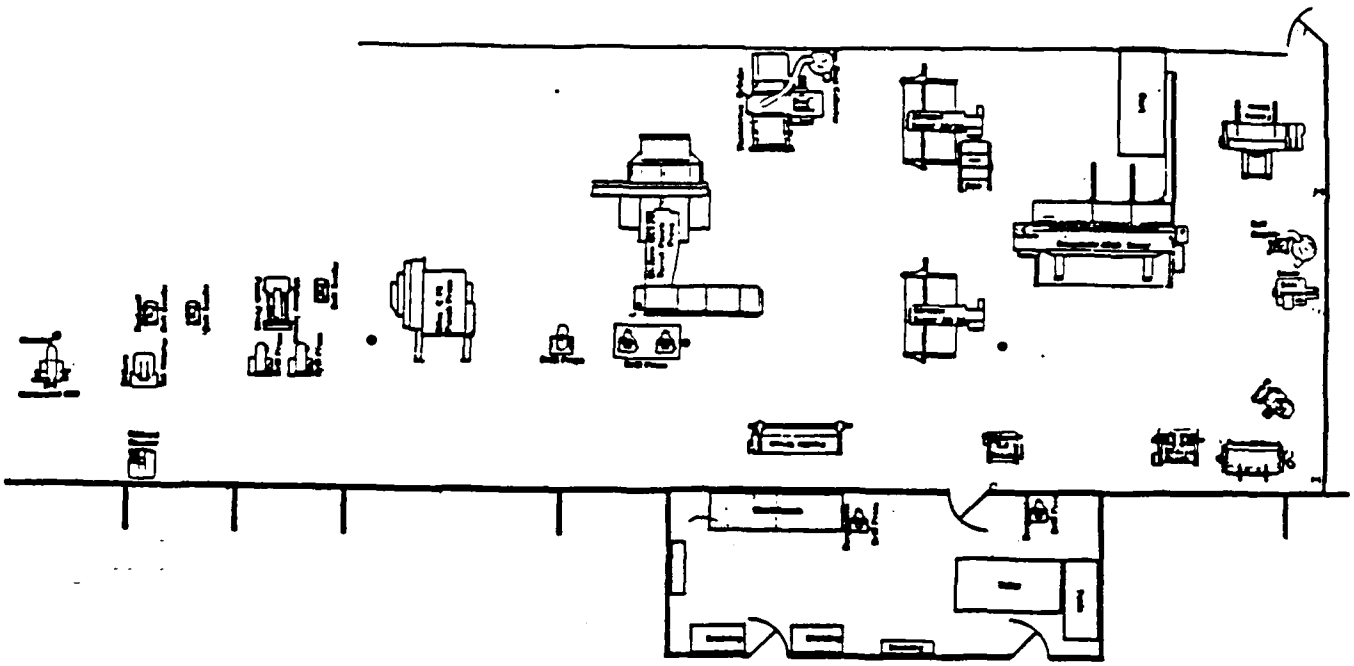
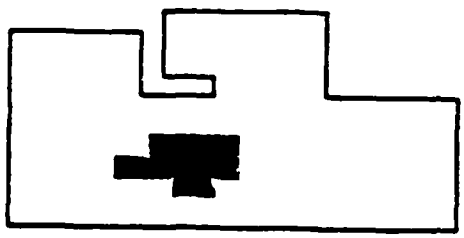


Figure 1-9. TOOL CRIB





BUILDING 2

Figure 1-10. SHEET METAL SHOP LAYOUT

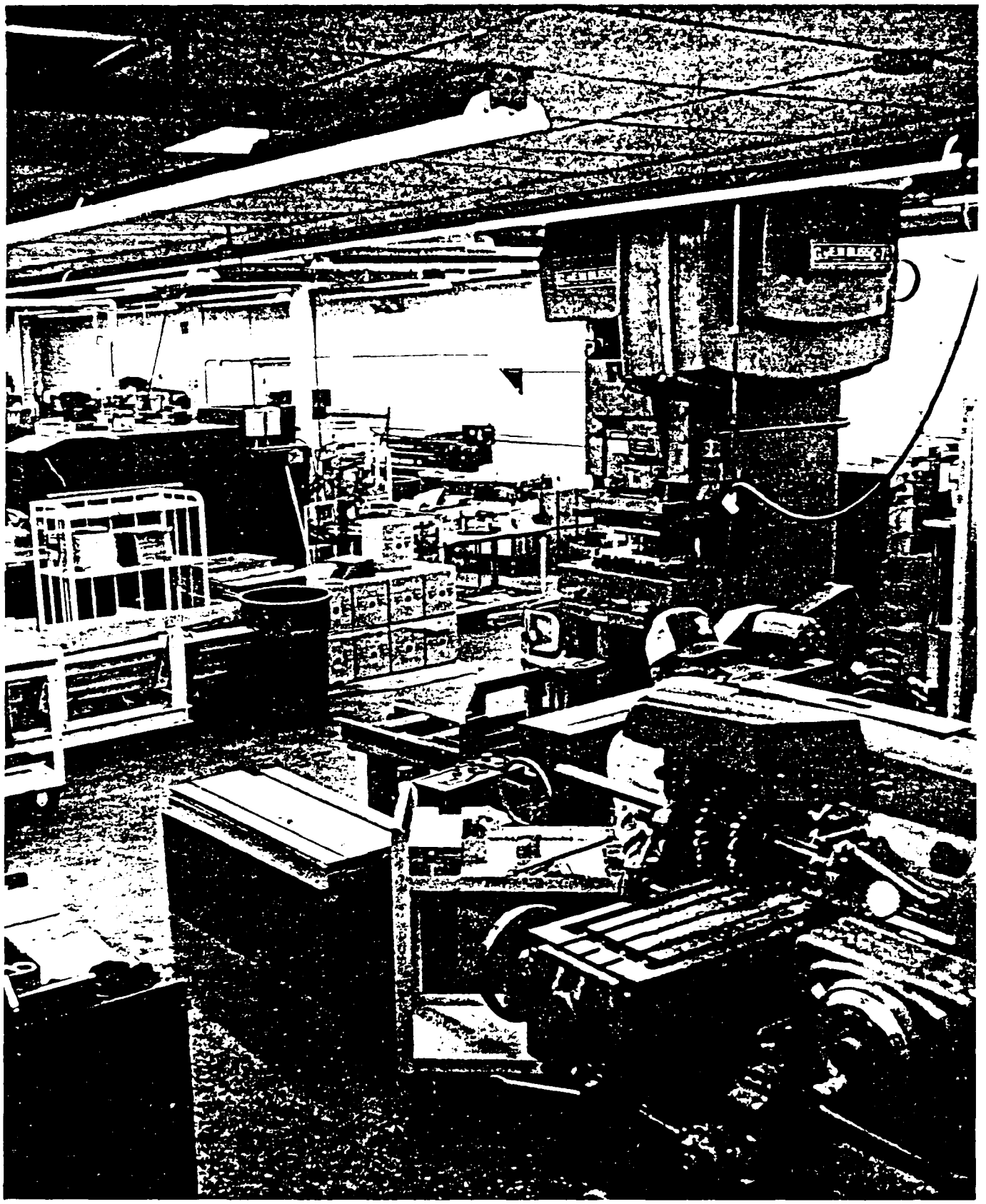


Figure 1-11. SHEET METAL SHOP

MACHINE	QTY	YEAR OF PURCHASE	CONDITION
Di-Acro Press Brake Model 14-48-2, 6 Ton	1	1969	Fair
Farm-All Brake Model 418HH	1	1962	Poor
Cincinnati Shear Model 39842	1	1976	Good
Famco Shear Model 1252	1	1963	Fair
Time Saver Grinder Model 225MI	1	1976	Good
Strippit Fabricator Model 386, 30 Ton	2	1964 1976	Fair
Di-Acro Tab Notched Model 2	1	1966	Poor
Whitney-Jensen Punch Press, Model 130	1	1966	Poor
Bliss Punch Press Model C-75, 75 Ton	1	1976	Good
N.C. Di-Acro Turret Punch Press Model OCT-20	1	1979	Good
Doall Vertical Band Saw Model 3012-4	1	1965	Poor
Doall Horizontal Band Saw Model C-4A	1	1971	Fair
Milford Riveter Model S-255	1	1979	Fair
Gardner-Denver Compression Riveter Model S2A3, 90 PSI	3	1978	Good

Figure 1-12. SHEET METAL SHOP CAPITAL EQUIPMENT

1.2.4 Raw Stock Storage Area - AS IS - The Raw Stock Storage Area, shown in Figures 1-13 (layout) and 1-14 (photo), is used to store aluminum and stainless steel sheets, aluminum plates, extrusions, bar stock and angle stock. It is controlled by one (1) material handler who shears, saws and mills raw stock for use in subsequent fabrication operations.

The storage area occupies approximately 940 square feet. Increased production requirements and limited storage space has caused some stock to be stored on the receiving dock. The entrance to raw stock storage area is through a 9' x 9' overhead door. The door is located in an awkward position for delivering 12 ft. long stock to the area by fork lift. Improvements being brought about in this area will increase the productivity of the material handler as well as reduce time required to clean stock stored on the receiving dock.

1.2.5 Weld Shop - AS IS - The Weld Shop is staffed by three (3) welders who are supervised by the Sheet Metal Shop supervisor. Most of the parts requiring welding are aluminum with a small amount of stainless steel which is processed in the Sheet Metal Shop. It occupies 537 square feet. Figure 1-15 shows the layout and a listing of the equipment. Crowded conditions, shown in the photo in Figure 1-16, do not permit space for bevel-grinding. Instead, the welder must transport parts a distance of 270 feet round trip to the 4" Belt Grinder located in the Sheet Metal Shop. In addition, the parts coming directly to the Weld Shop from the Sheet Metal Shop have no convenient access to that area and must travel a circuitous route of 160 feet, through the Machine Shop, to get there.

1.2.6 Mold Shop - AS IS - The Mold Shop is manned by one (1) operator who is responsible for the storage and maintenance of molding materials as well as the set-up and operation of the two (2) Arburg Injection Molding Machines (77 Ton and 13 Ton). It is located in an area that is exposed to outside and metal finishing environment and occupies approximately 620 square feet.

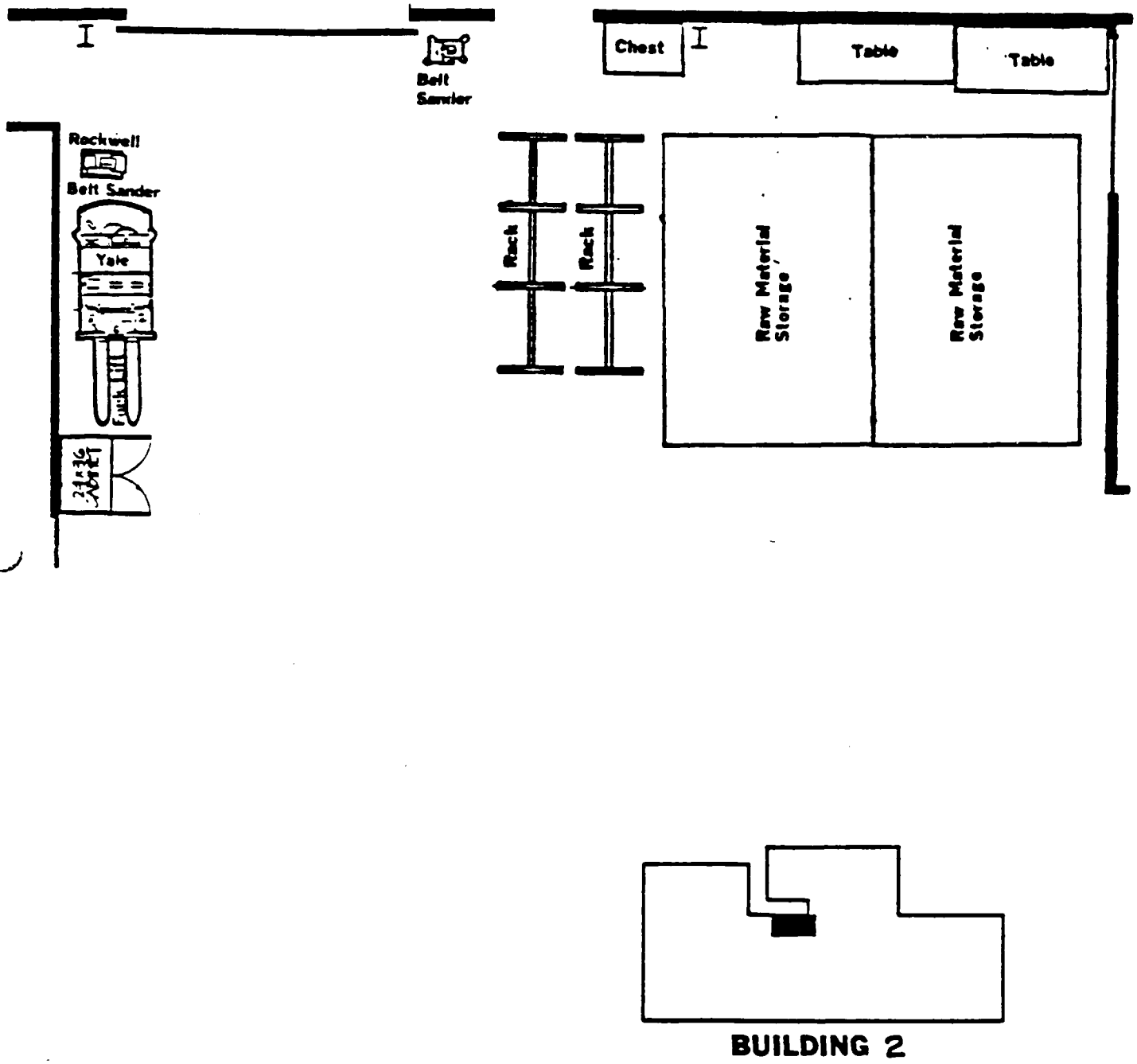


Figure 1-13. RAW STOCK STORAGE AREA LAYOUT

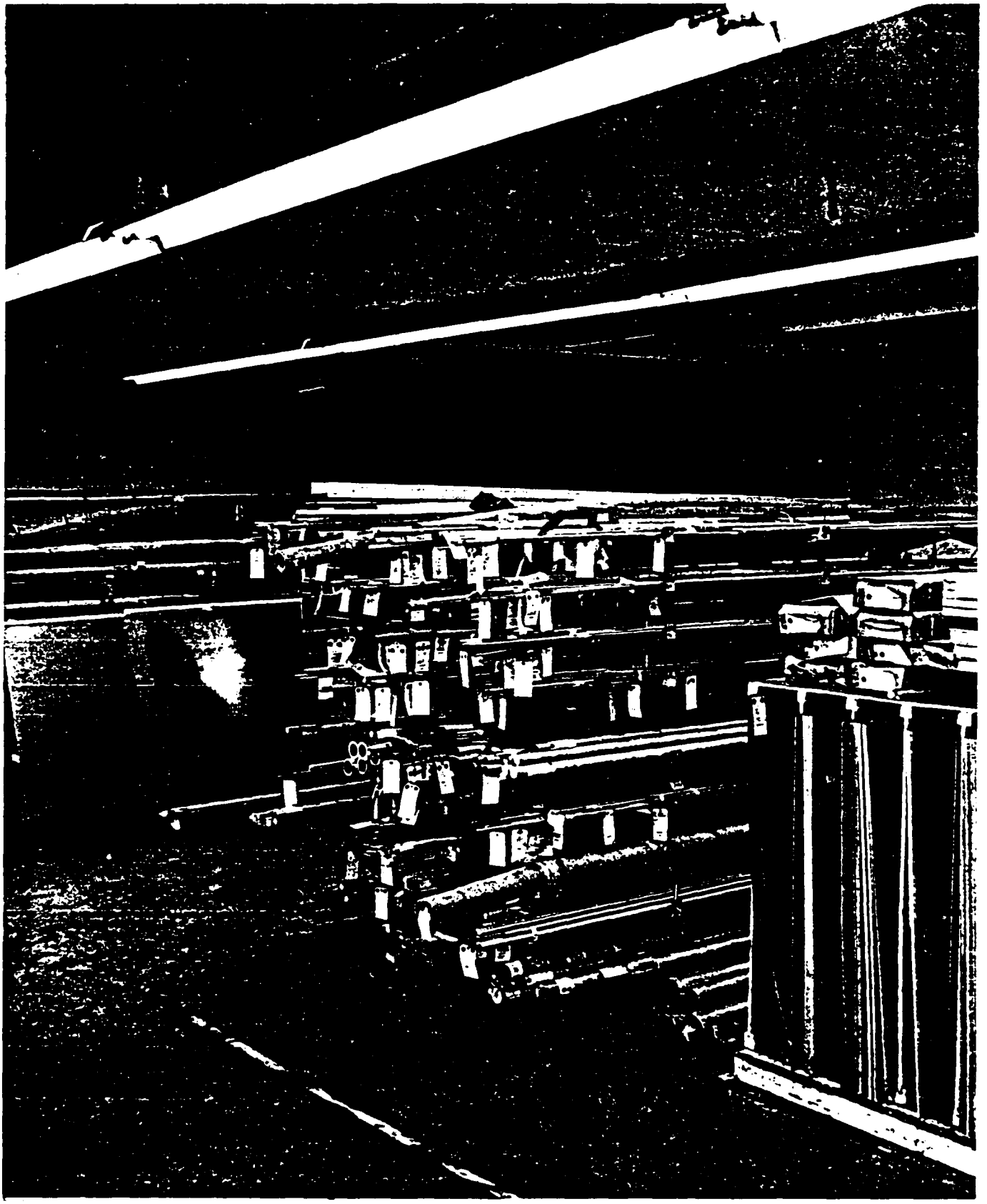
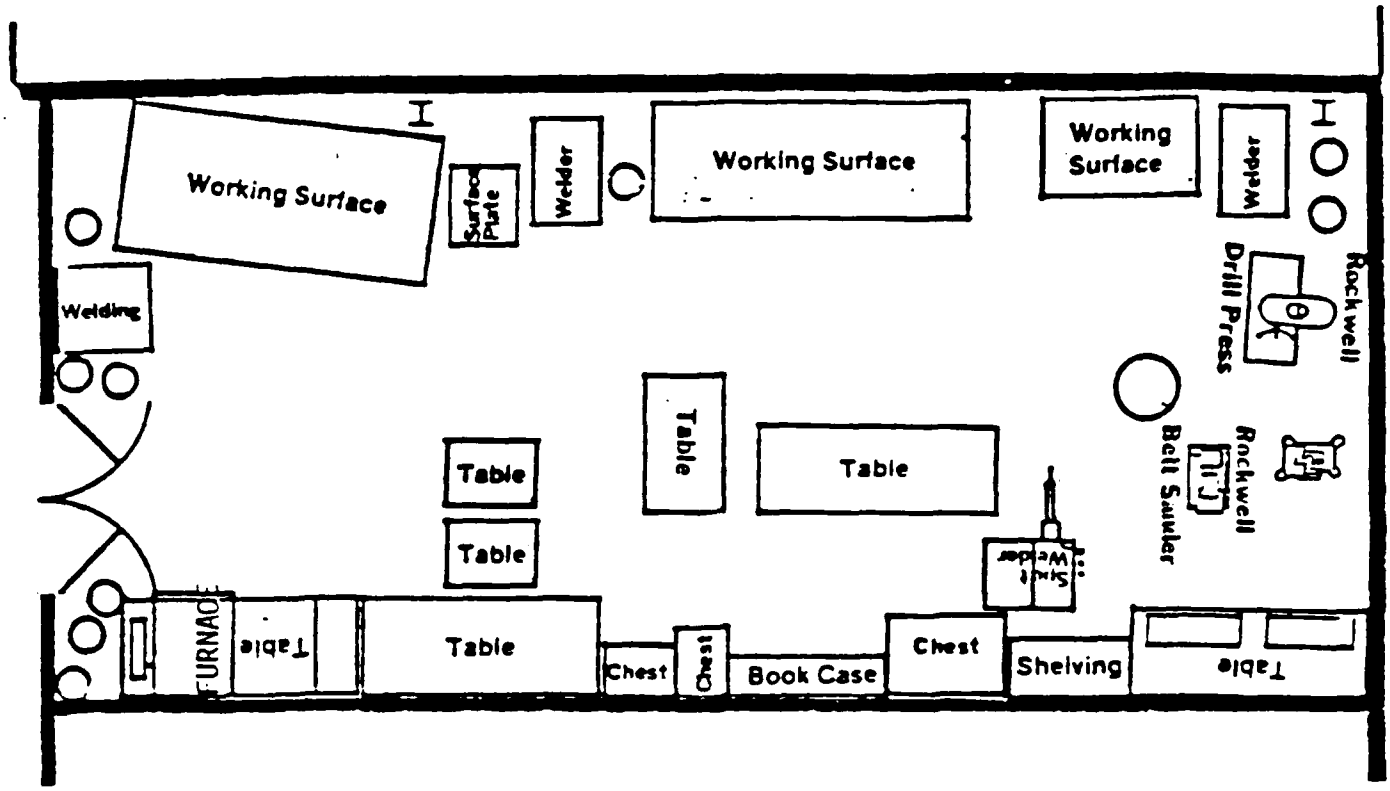
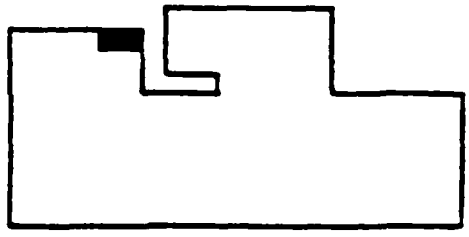


Figure 1-14. RAW STOCK STORAGE AREA





BUILDING 2

MACHINE	QTY	YEAR OF PURCHASE	CONDITION
Heliarc Welder, 200AMP, 30% 300AMP, 35%	2	1966 1970	Fair Fair
Ideal Arc Welder, 300AMP, 60%	1	1965	Fair
Universal Spot Welder, Model RAS	1	1966	Fair
Sybron Furnace, Model F-A1740, Heat Treat, 1093°C Limit	1	1977	Fair

Figure 1-15. WELD SHOP LAYOUT AND EQUIPMENT LISTING

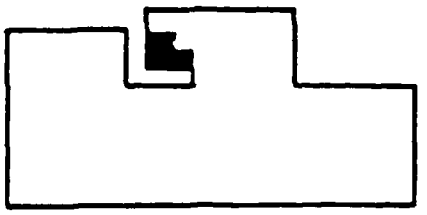
Figure 1-16. WELD SHOP

Approximately 65 individual parts are molded on the two (2) molding machines, with lot sizes ranging from 30 to 10,000 parts. Scrap losses are excessive, caused by the poor condition of the small mold machine, and the lack of proper atmospheric control. Both machines must be continuously monitored in order to maintain the required process controls and ensure that part tolerances are maintained.

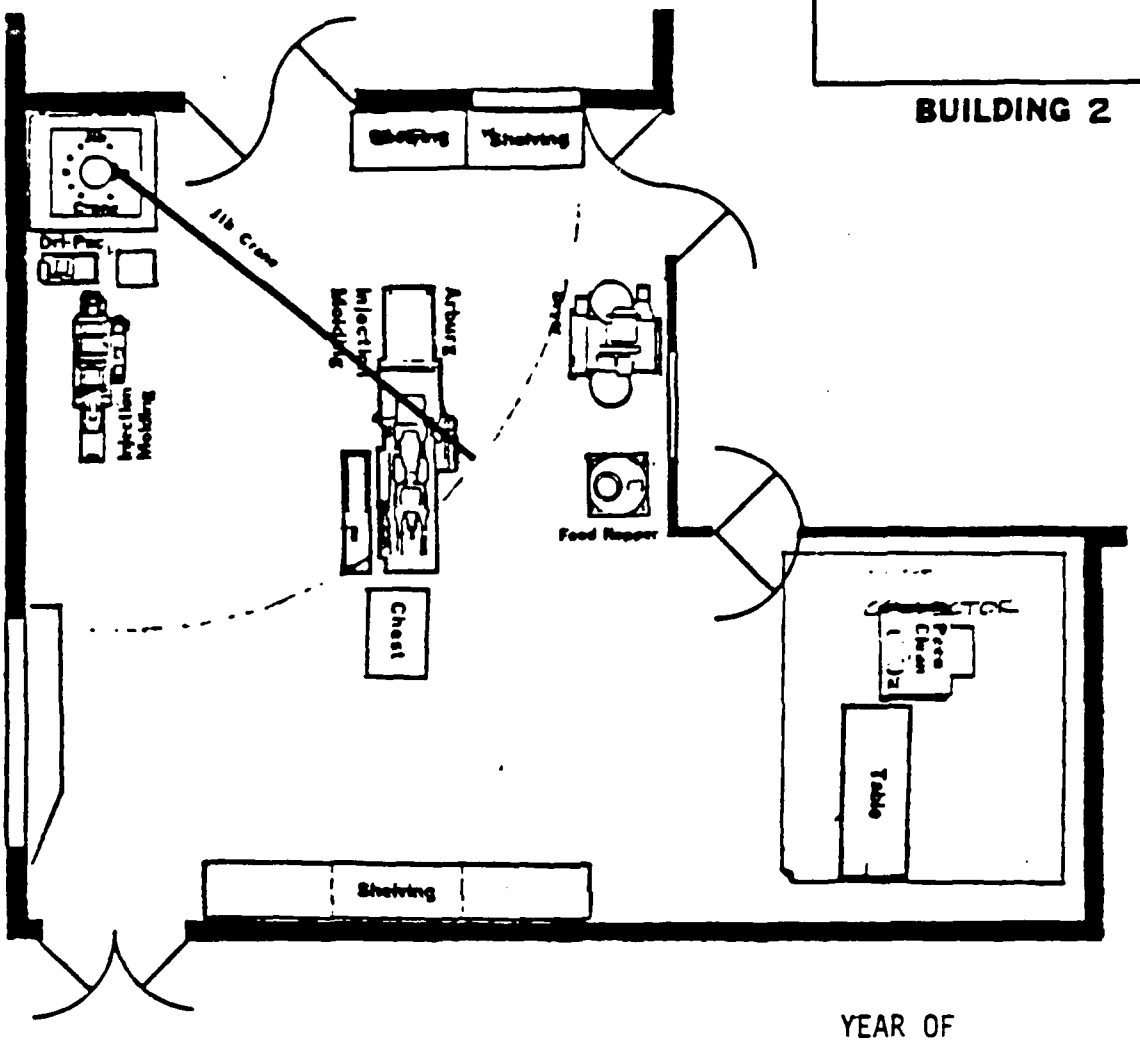
The shop's layout and equipment listing are shown in Figure 1-17, with a photo in Figure 1-18.

1.2.7 Tool and Model Shop - AS IS - The Tool and Model Shop is staffed with thirteen (13) tool and model makers and one (1) supervisor, occupying 3546 square feet as shown in the equipment layout, Figure 1-19. A listing of the capital equipment is provided in Figure 1-20, with a shop photo in Figure 1-21.

Approximately 60% of the workload is fabrication of engineering prototype machined parts. The remaining workload is tool making, producing jigs, fixtures and holding devices required by the Machine Shop and other manufacturing departments.



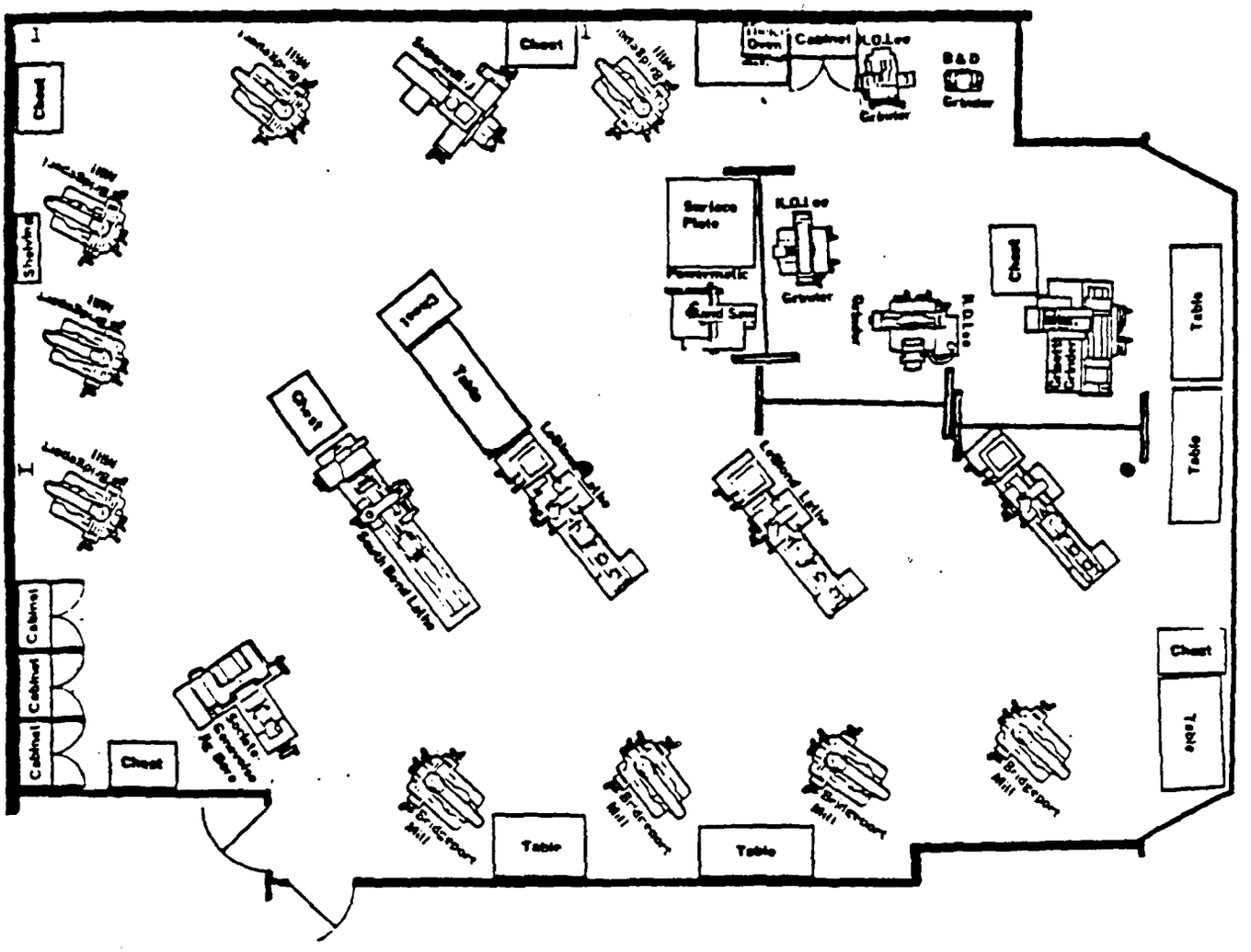
BUILDING 2

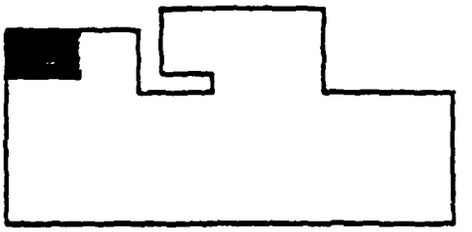


MACHINE	QTY	YEAR OF PURCHASE	CONDITION
Arburg 77 Ton Injection Molding Machine 6 oz. shot capacity	1	1980	Good
Arburg Model 100 13 Ton Injection Molding Machine, 0.6 oz. shot capacity	1	1960	Poor
Advantage Engineering Mold Temperature Controller (Oil/450° F)	1	1980	Good
Advantage Engineering Mold Temperature Controller (Water/250° F)	1	1980	Good
Grieve Convection Oven 18" x 17" x 13"	1	1980	Good
Advantage Engineering Hopper Loader	1	1980	Good
Arburg Hopper Dryer	1	1977	Good
Nova-Tech Twin Bed Dessicant Dryer	1	1980	Good

Figure 1-17. MOLD SHOP LAYOUT AND EQUIPMENT LISTING

Figure 1-18. MOLD SHOP





BUILDING 2

Figure 1-19. TOOL AND MODEL SHOP LAYOUT

MACHINE	QTY	YEAR OF PURCHASE	CONDITION
Bridgeport Mills, Series II, w/Digital Readout, Power Feed and Variable Speed Head	8	1976	Good
Bridgeport Mill, 1½ hp	1	1966	Poor
Supermill Milling Machine, 2 hp	1	1971	Fair
Sebastian Engine Lathe, 14" swing, 36" Between Centers	1	1972	Fair
LeBlond Engine Lathe, 15" swing, 36" Between Centers	1	1966	Fair
LeBlond Engine Lathe, 15" swing, 54" Between Centers	1	1980	Good
Southbend Engine Lathe, 16" swing, 48" Between Centers	1	1966	Fair
Monarch EE Toolroom Engine Lathe	1	1976	Good
K. O. Lee Universal Grinder	1	1969	Fair
K. O. Lee Universal Grinder	1	1965	Good
Jotes Surface Grinder, 12" x 18" Working Surface	1	1980	Good
Grisetti Grinder, OD and ID, 12" swing 20" Between Centers	1	1978	Good
Powermatic Band Saw, 19" throat depth	1	1970	Fair
Roll-in Band Saw	1	1980	Good
GSIP Jig Bore	1	1967	Good
Tempering Oven	1	1967	Fair
Thermolyne Heat Treating Oven, 16" x 10" x 8"	1	1977	Good

Figure 1-20. TOOL AND MODEL SHOP CAPITAL EQUIPMENT

2.0 PROJECT DESCRIPTION

The initial thrust of this project was the identification and early procurement of specific NC/CNC machine tools in order to increase the machining department's capability and accuracy. Of equal importance, however, was the work cell analysis that was conducted, and the associated attention given to material handling and work flow. This led to facility rearrangements and additional methods improvements. The overall analysis generated a comprehensive "master plan", which impacted all shop areas in Building 2 and yielded productivity improvements beyond what was originally envisioned.

Project costs are shown in Chapter 3 and include capital equipment purchases, capital and expense expenditures for facilities rearrangements, and capital and expense labor incurred by the Manufacturing Engineering Department, the Project Investigator, and Quality Engineering.

Savings for the project are shown in Chapter 4 and are based on individual conditions applicable to the particular improvement. Production system requirements were obtained from our Product Design and Development Division's Five-Year Plan and the current build schedule. The direct labor costs for each system is based on man-hours expended prior to implementation of any improvements. A composite description of the savings in the different areas will be presented later in this section (Figure 2-13).

2.1 Proposed Improvements

During the development phase of this project approximately sixty (60) ideas concerning equipment, layout, or methods changes were discussed and investigated. Those that proved to be impractical or too expensive when compared to their payback were rejected and will not be presented here. The items that proved feasible and enhanced productivity are shown below. The major items of equipment are described in paragraphs 2.1.1 through 2.1.5 and it was these items that contributed most heavily to overall savings. Improvements relating to methods and layout changes, etc. are detailed in paragraphs 2.1.6 thru 2.1.14 and are shown in the block diagram layout in Figure 2-1,

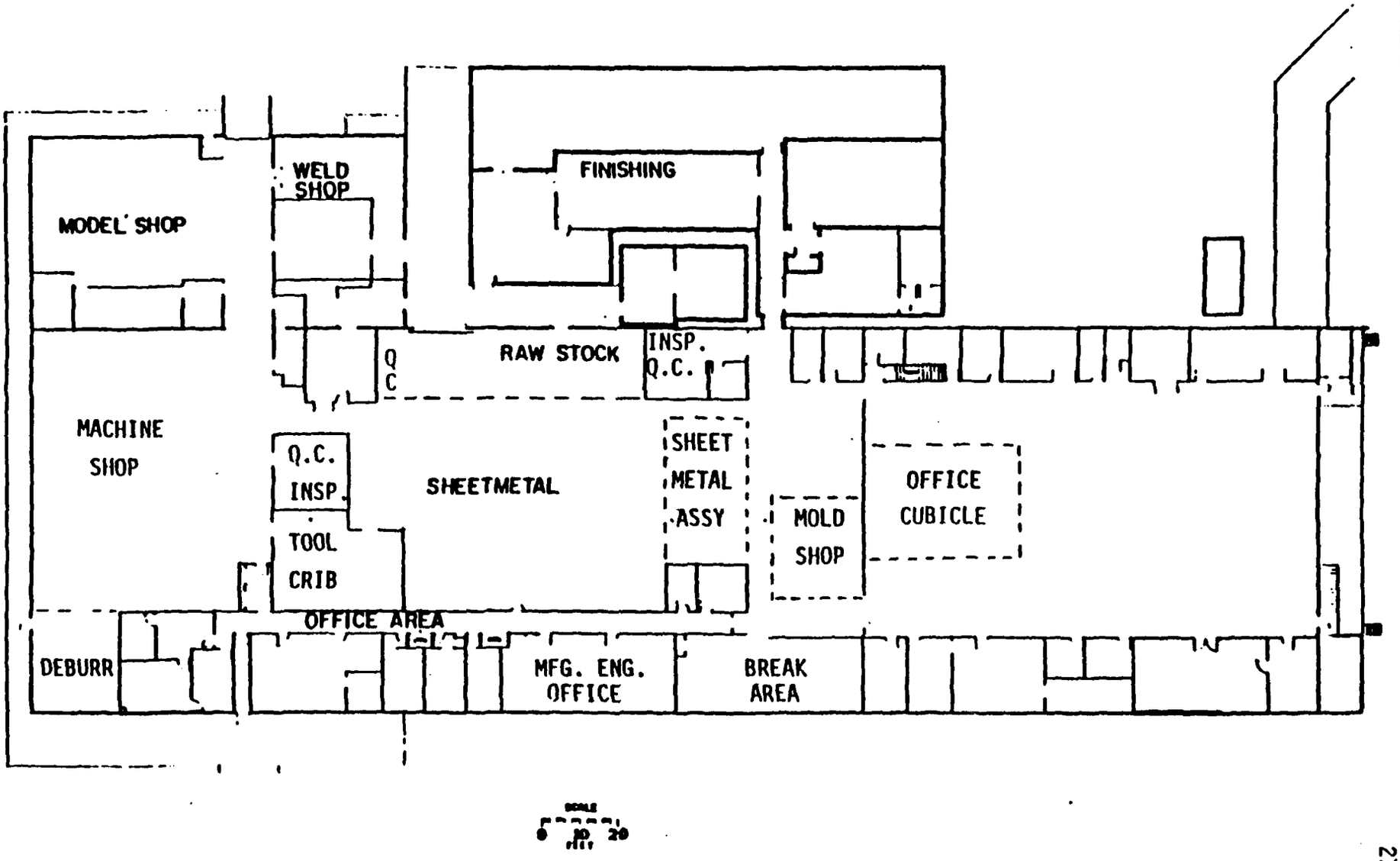


Figure 2-1. IMPROVED BUILDING 2 LAYOUT ("MASTER PLAN")

which represents the overall "master plan" for the machine shop facilities. Paragraph 2.1.15 covers office relocation costs.

2.1.1 Kuraki Horizontal Milling Cells - During the fourth quarter of 1982, two (2) C.N.C. Kuraki Horizontal Milling Machines, Model M-H-400, with shuttles, were procured. They were installed in the Machine Shop in March 1983. Each machine forms the nucleus of a work cell, composed of additional secondary equipment. The operators perform secondary milling, drilling, tapping and deburring operations during the controlled machining cycle. A photo is shown in Figure 2-2.

Approximately forty-five (45) different parts are processed through these work cells. The work cells deleted many manually operated milling, drilling and tapping operations performed on "open" set-ups. The change resulted in direct labor savings of up to 60% on the forty-five (45) parts affected, based on a comparison of the old method versus the new Kuraki work cell methods. Each of these parts required the development of C.N.C. programs.

2.1.2 Amada Press Brake - A C.N.C. Amada Press Brake, Model RG-355S, Figure 2-3, was also procured during the fourth quarter of 1982. It was installed in the Sheet Metal Shop in February 1983. It replaced an obsolete press brake that required individual set-up and form operations for each different angular bend or bend length on multiple bend sheet metal parts.

The Amada Press Brake is programmed to form all multiple bends, using a set-up of multiple dies. The operator follows a prescribed bend sequence while forming the bends on a sheet metal part. Approximately 56 parts are being run on the new machine. By eliminating separate set-up and bend operations, direct labor in the bending of these parts has been reduced by an average of 35% based on a comparison of the old set-up and run times versus the same times with the new Amada.

2.1.3 Numeridex LC7000 - A Numeridex LC7000 was purchased in April 1983 for use by the two (2) NC Programmers in Building 2. It is a programmable computer used to produce punched tapes for the CNC Kurakis.

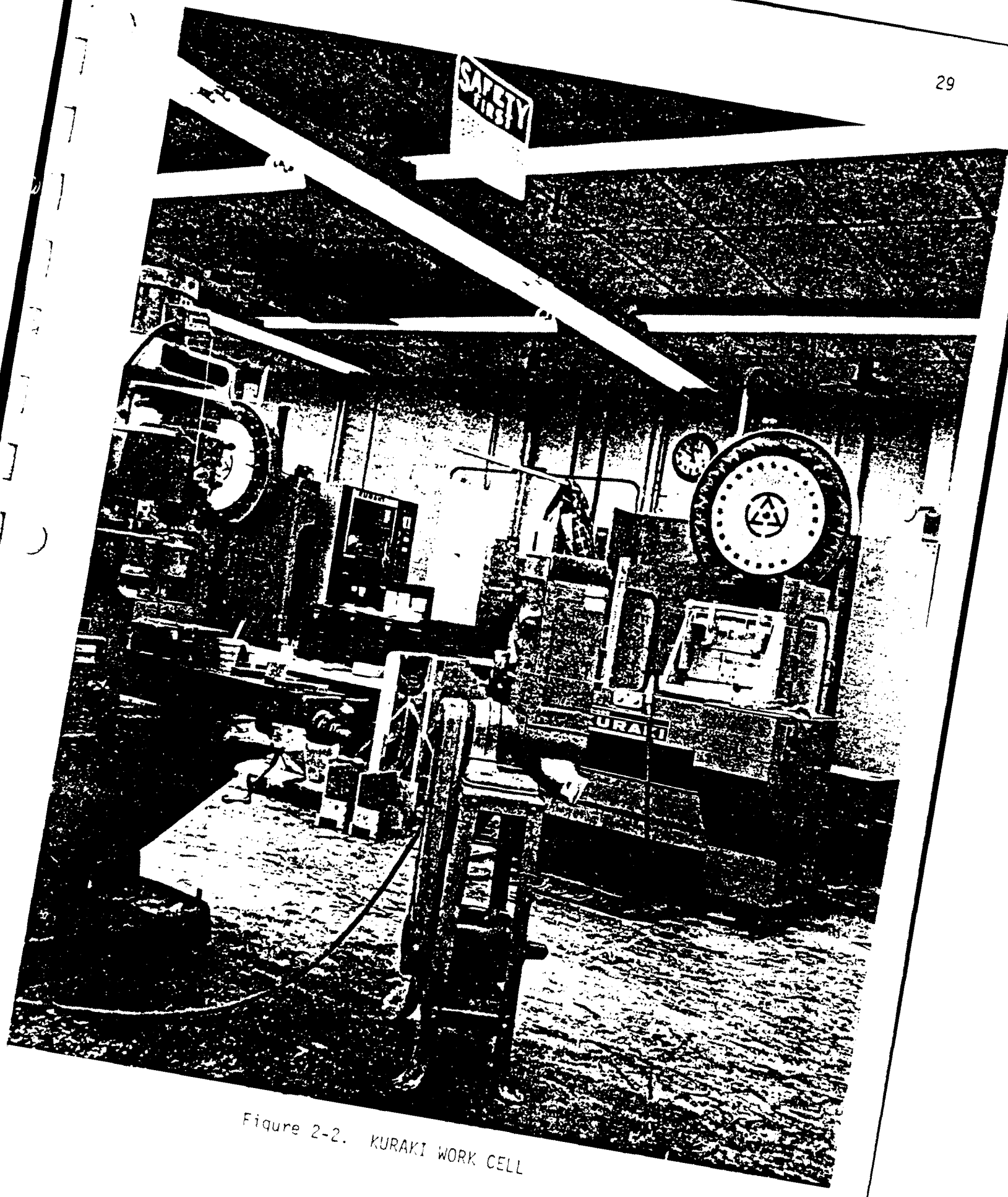


Figure 2-2. KURAKI WORK CELL

Figure 2-3. AMADA PRESS BRAKE

2.1.4 Arburg Injection Molding Machine - A new Arburg Allrounder Mold Machine, 28 Ton, Model 221/170R, 0.8 oz. shot capacity, was procured in August 1983 and is shown in the photo in Figure 2-4. It replaced an old Arburg 100 (13 Ton) which was outmoded and 23 years old. The location and condition of the Arburg 100 caused scrap labor and material, as well as downtime for equipment repair. The new mold machine, in its projected location, will reduce direct labor by 10%, while reducing scrap labor by 50%, and virtually eliminate downtime caused by equipment malfunctions.

2.1.5 Helicoil Assembly Tool - One (1) Electric Perma Thread Gun #SBT 209G with transformer was purchased in September 1983 for use in installing helicoils in sheet metal parts and other hardware in the Sheet Metal Assembly Area. The old procedure required helicoils to be installed by hand cranked mandrels, resulting in a slow insertion method as well as rework caused by the insert tang breaking off prematurely. Use of the Helicoil Assembly Tool should save approximately 70% of the helicoil assembly labor.

2.1.6 Coordinate Measuring Machine - A Boice Precision Measuring machine was purchased under a separate Tech Mod project in December and installed in Building 2. It required 400 square feet and was strategically placed between the Machine Shop and Sheet Metal Shop for better overall work flow.

2.1.7 Machine Shop - Following the completion of the Master Plan and acquisition of the Coordinate Measuring Machine several changes were made in the Machine Shop to facilitate work cell arrangements, avoid crowded conditions, and improve product flow through an expanded shop. Figure 2-5 shows the expanded Machine Shop and equipment layout, which includes 584 square feet gained by occupying currently used office space. Equipment that was moved included five (5) lathes, seven (7) milling machines, seven (7) refurbished drill and tap stations, and one (1) surface grinder.

Improvement of machining methods introduced by Manufacturing Engineering personnel, coupled with the facility changes, will make an important reduction in direct labor man-hours, eliminate crowded conditions, improve material handling and product flow.

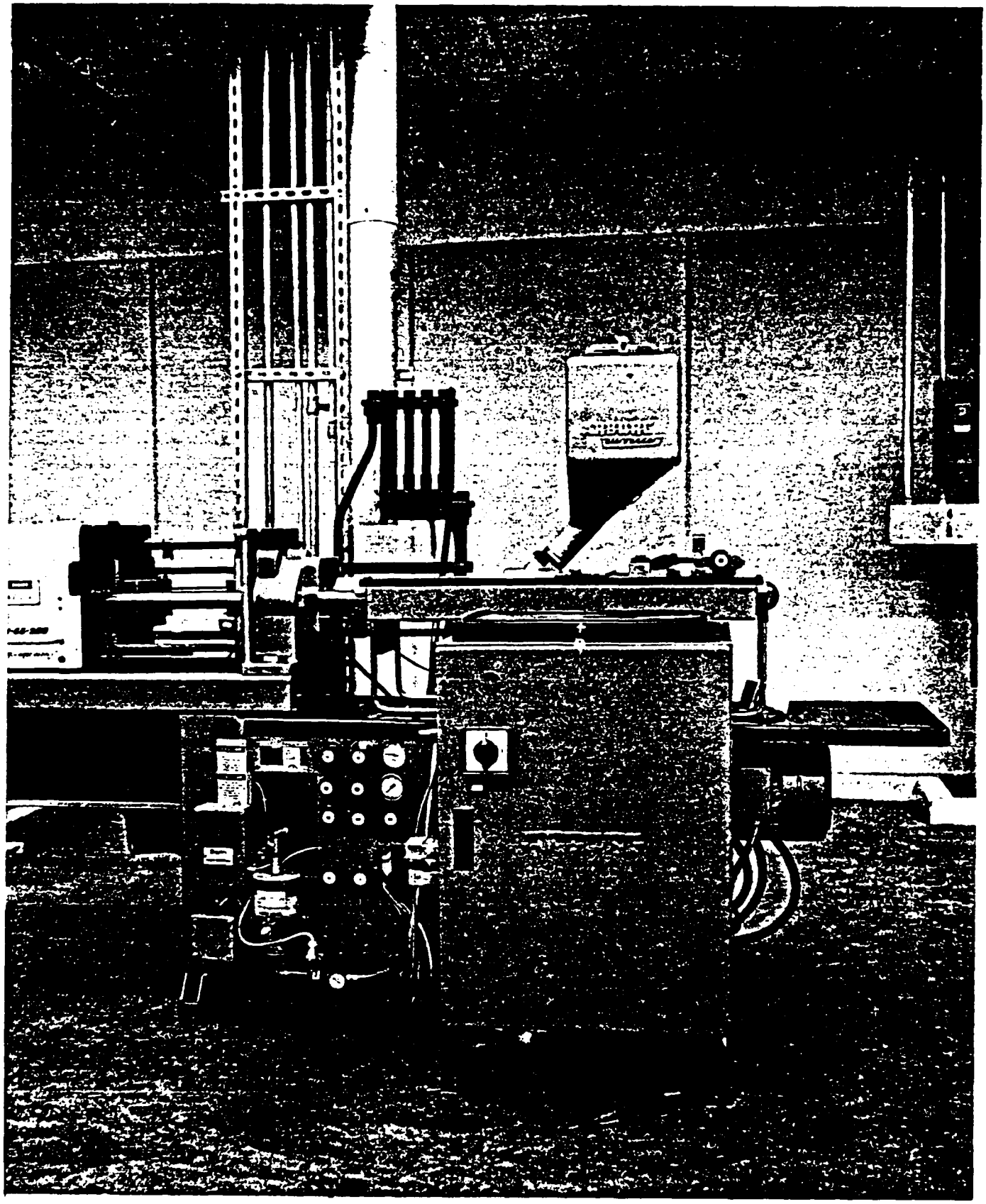


Figure 2-4. ARBURG MOLD MACHINE

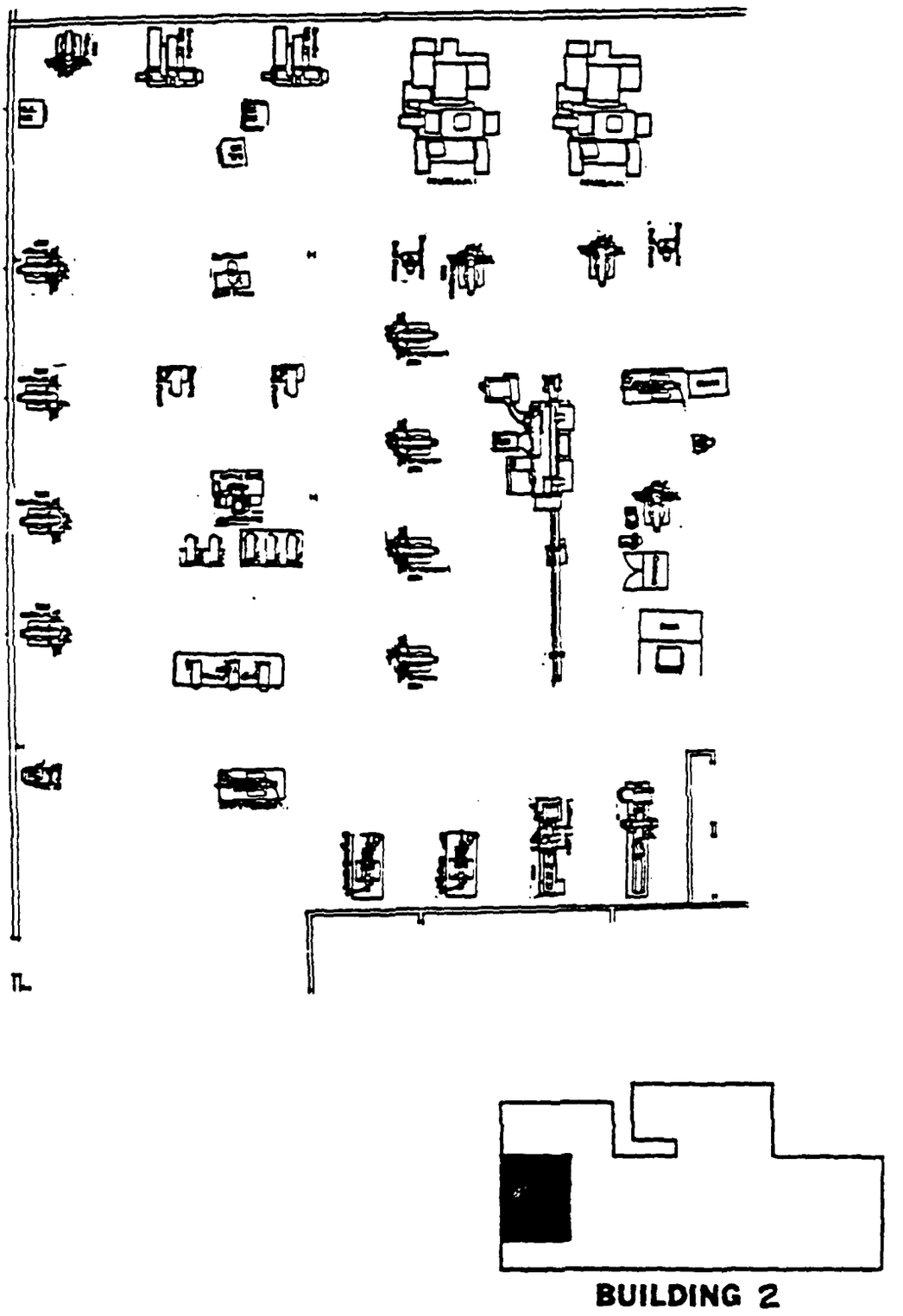


Figure 2-5. IMPROVED MACHINE SHOP LAYOUT

2.1.8 Tool Crib - Figure 2-6 shows the relocated/enlarged Tool Crib and equipment layout. Square footage increases from 590 square feet to 800 square feet. The new location is convenient for Machine Shop personnel, and for the transportation and storage of pre-cut parts to be machined.

It includes a separate crib for storing government tooling, a tool grinder, nine (9) new Lista modular tool and fixture storage cabinets, and one (1) Lista N.C. Tooling Preset Station for storage of N.C. tooling. Other shelves, file cabinets and storage cabinets were existing tool crib assets.

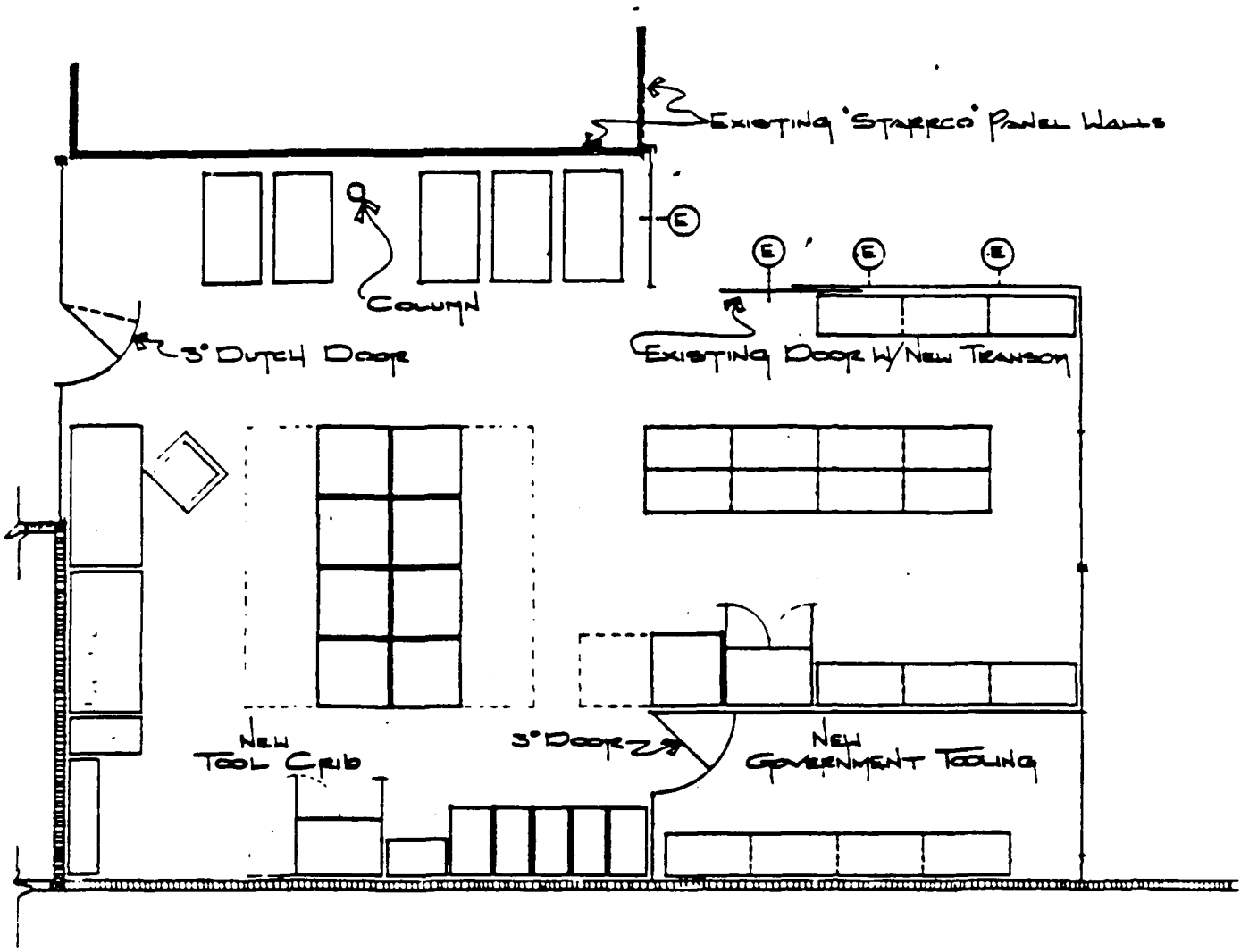
This equipment will expand the duties and responsibilities of the tool crib clerk to include kitting and presetting all cutting tools and fixtures according to improved process instructions. The kitting will be accomplished prior to the issuance of a work order to the shop floor. Also, the clerk will store and issue the required N.C./C.N.C. tapes.

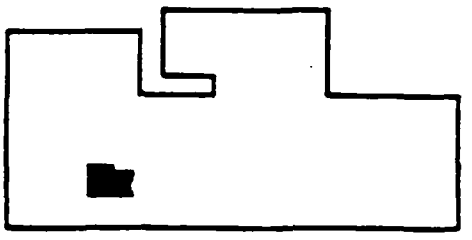
As a result of these changes, set-up times will be reduced, tool control and maintenance will be improved, and time lost by machine operators waiting to obtain tools and supplies from the crib will be minimized.

2.1.9 Sheet Metal Shop - Although the Sheet Metal Shop loses 800 square feet to the relocated Tool Crib, the "Master Plan" calls for an expansion of the shop to improve work flow and conform to the work cell philosophy. The shop therefore is being assigned additional space presently used as offices and a break area. Overall, the Sheet Metal Shop increases from 7,065 square feet to 7,716 square feet and the new layout is shown in Figure 2-7.

Equipment layout changes include three (3) punch presses, two (2) press brakes, one (1) time saver, twelve (12) small machines and twelve (12) work benches.

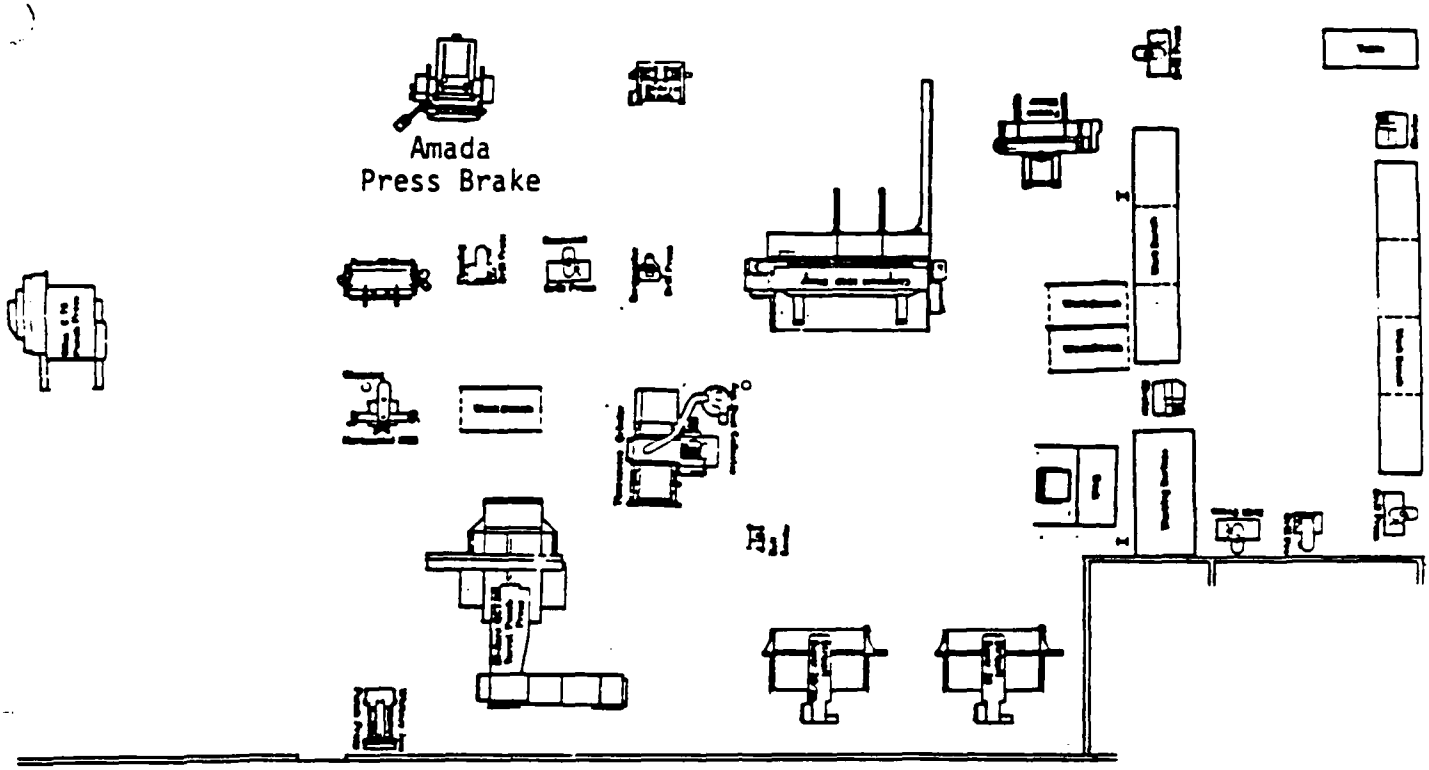
The facility changes improve product flow and material handling, minimize crowded conditions, provide a centralized fabrication kitting area, and reduce direct labor significantly.





BUILDING 2

Figure 2-6. IMPROVED TOOL CRIB LAYOUT



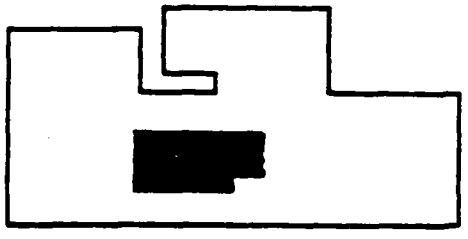


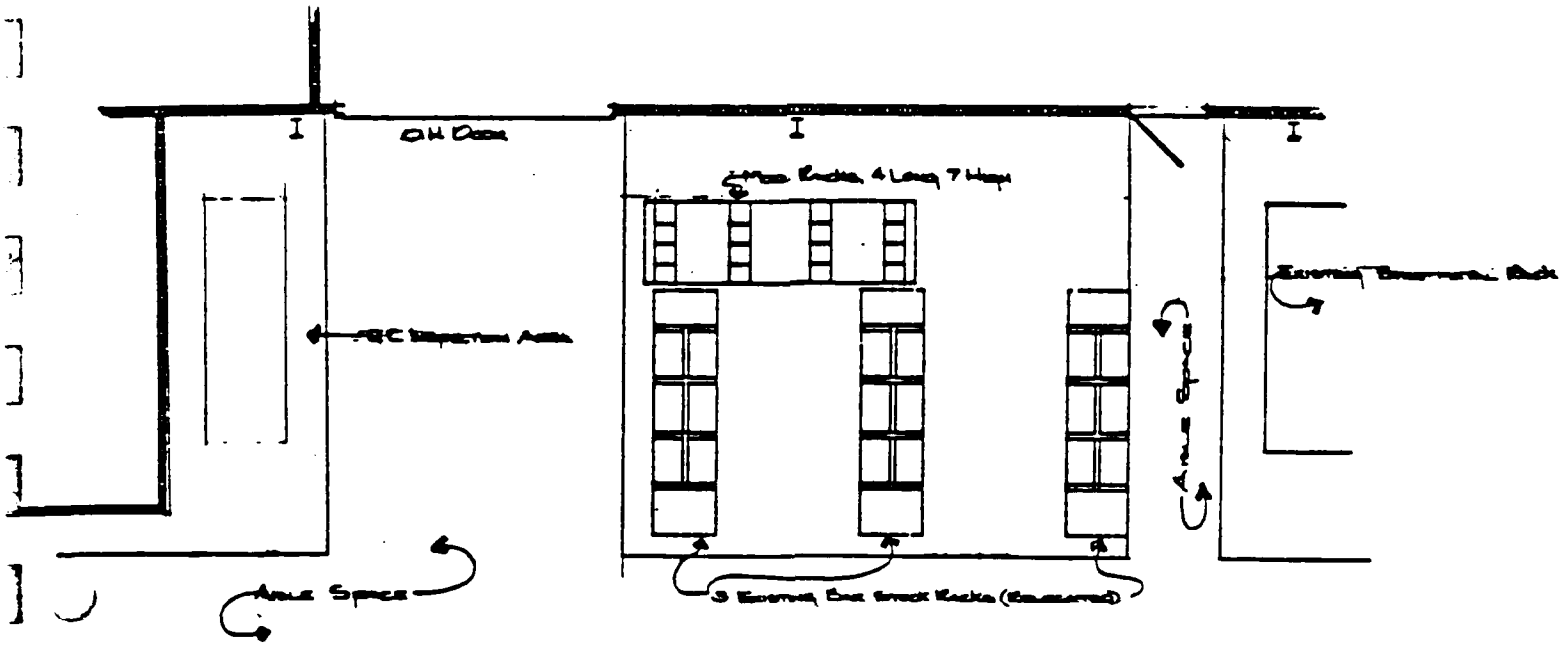
Figure 2-7. IMPROVED SHEET METAL SHOP LAYOUT

2.1.10 Raw Stock Storage Area - The layout of the expanded Raw Stock Storage Area is shown in Figure 2-8. The area increases from 940 to 1440 square feet. This expansion requires the removal of 82 linear feet of office walls. rearrangement of light fixtures, switches, one (1) power panel and the removal of a 9' x 9' overhead door. Work also includes filling in the outer wall where the overhead door was located, installing the larger 9' x 14' electrically controlled overhead door with a thermoshield covering, and the assembly of an additional bar stock rack.

The improvements provide a larger entrance for moving stock on fork lifts from the outer dock directly into the storage area, as well as an internal holding area for receiving inspection. Material handling of bar stock is reduced by providing adequate space to store this stock directly from pallets into the holding racks. The additional space will also eliminate the problem of having to clean sheet and plate stock stored on the outer dock.

The material handling savings will allow the material handler to do additional shearing of sheet metal parts and the sawing and milling of raw stock to be used in the Machine Shop.

2.1.11 Weld Shop - The expanded Weld Shop is shown in Figure 2-9. It becomes "L" shaped and gains an additional 200 square feet, going from 537 to 737 square feet. The expansion provides space for the 4" Belt Grinder, thus permitting bevel-grinding of all parts right in the shop instead of transporting some of them to the Sheet Metal Shop. The expansion also provides space for an Electrostatic Air Cleaner which will remove grinding dust from the grinding area and improve the environment as well as employee morale. Figure 2-9 also shows the door which can now be used for parts incoming from the Sheet Metal Shop, reducing the one way travel distance from 160 feet to 60 feet. The changes also reduce crowded conditions and will bring about a noticeable reduction in direct labor hours in welding.



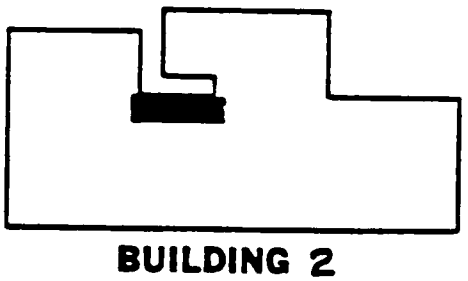


Figure 2-8. IMPROVED RAW STOCK STORAGE AREA LAYOUT

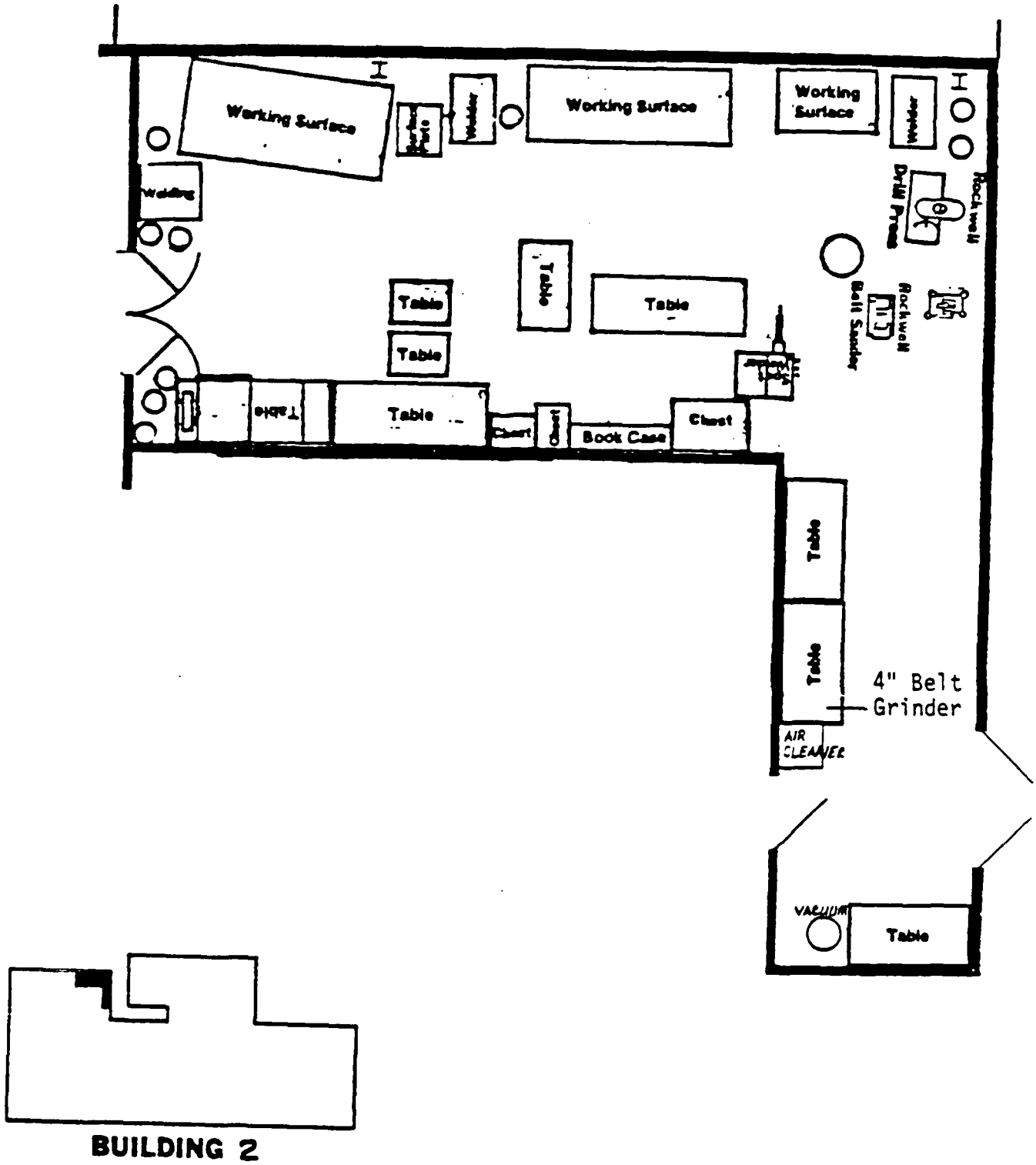


Figure 2-9. IMPROVED WELD SHOP LAYOUT

2.1.12 Mold Shop - The relocation of the Mold Shop equipment and the installation of the new mold machine is shown in Figure 2-10. This location solves the atmospheric problems and eliminates the problems caused by fumes from the metal finishing tanks. Savings (reduced downtime, reduced scrap labor) are included in paragraph 2.1.4, above, relating to the new Arburg Mold Machine.

2.1.13 Tool and Model Shop - The rearrangement of equipment in this shop is shown in Figure 2-11. It provides space for the installation of additional equipment, facilitates the flow of the product mix, and reduces the time required for daily shop clean-up which is performed by thirteen (13) tool and model makers.

2.1.14 Deburring Work Cell - The Deburring Work Cell was an idea stemming from the master plan/work flow analysis and its location is shown in Figure 2-12, adjacent to the Machine Shop. This work cell brings the Sweco Tumbling Mill and most of the manual grinders and belt sanders into one area.

Currently the Sweco is located in the extreme end of the Finishing Shop. Installing it in the Deburring Work Cell reduces the transportation of each lot for tumbling deburring an average of 490 feet. Further enhancements include reduced material handling, improved product flow, and improved supervision.

The major savings produced by this work cell will be in the material handling of approximately 15 lots weekly to and from the Sweco Tumbling Mill.

2.1.15 Additional Facility Costs - Twelve (12) employees will be displaced by the relocation of the Tool Crib and the expansion of the Machine and Sheet Metal Shops. The new office cubicles for these people are shown in Figure 2-1. The area is 105 square feet smaller in size than the previous office location and required the purchase of 53 each 5' x 5' Conwed Sight Screens to partition off the area. The cost of the screens and connecting hardware at $5,830 was considerably less expensive than dry wall construction, estimated at $14,000. In addition the new arrangement provides better utilization of floor space and flexibility for future changes, if required.

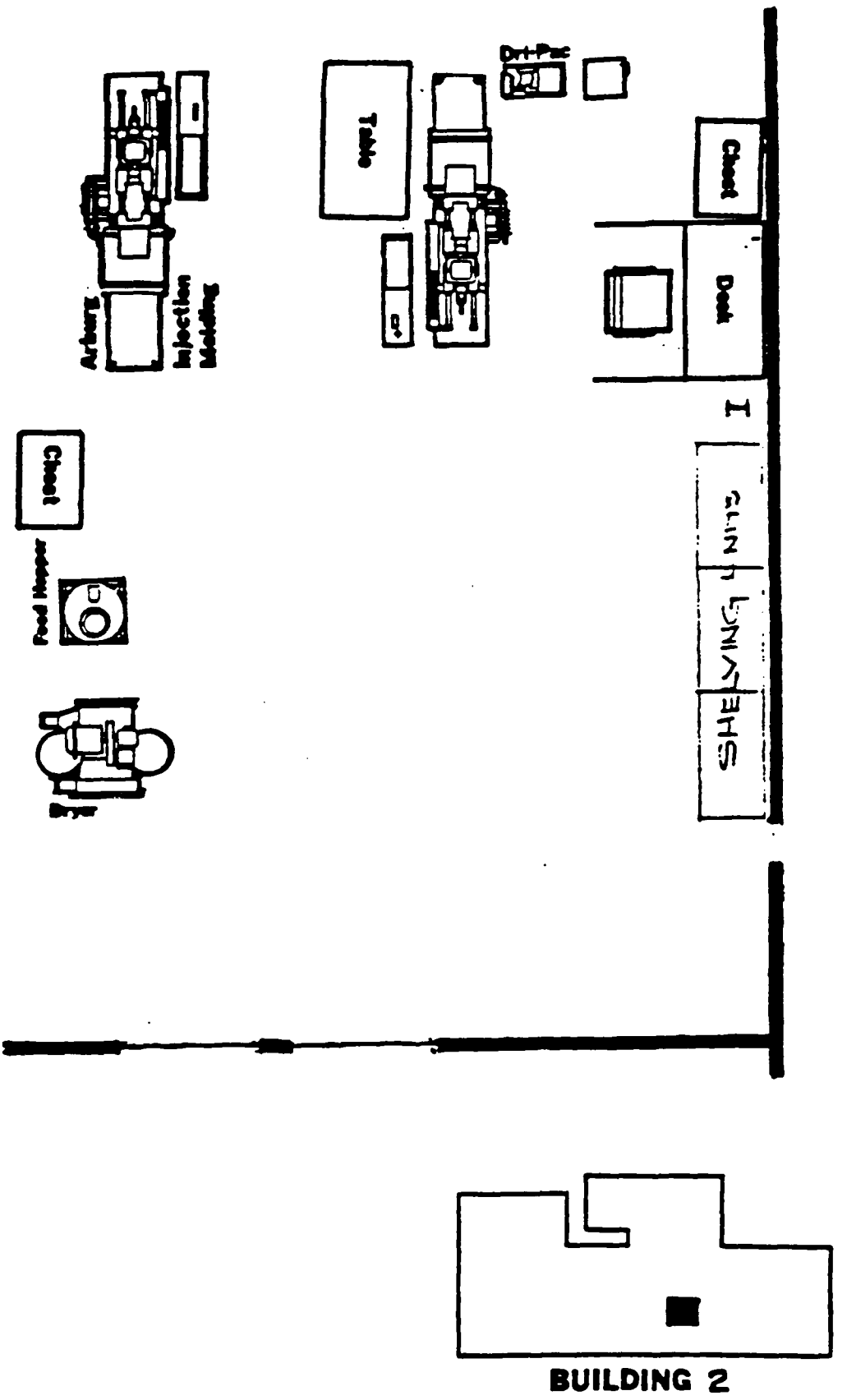


Figure 2-10. IMPROVED MOLD SHOP LAYOUT

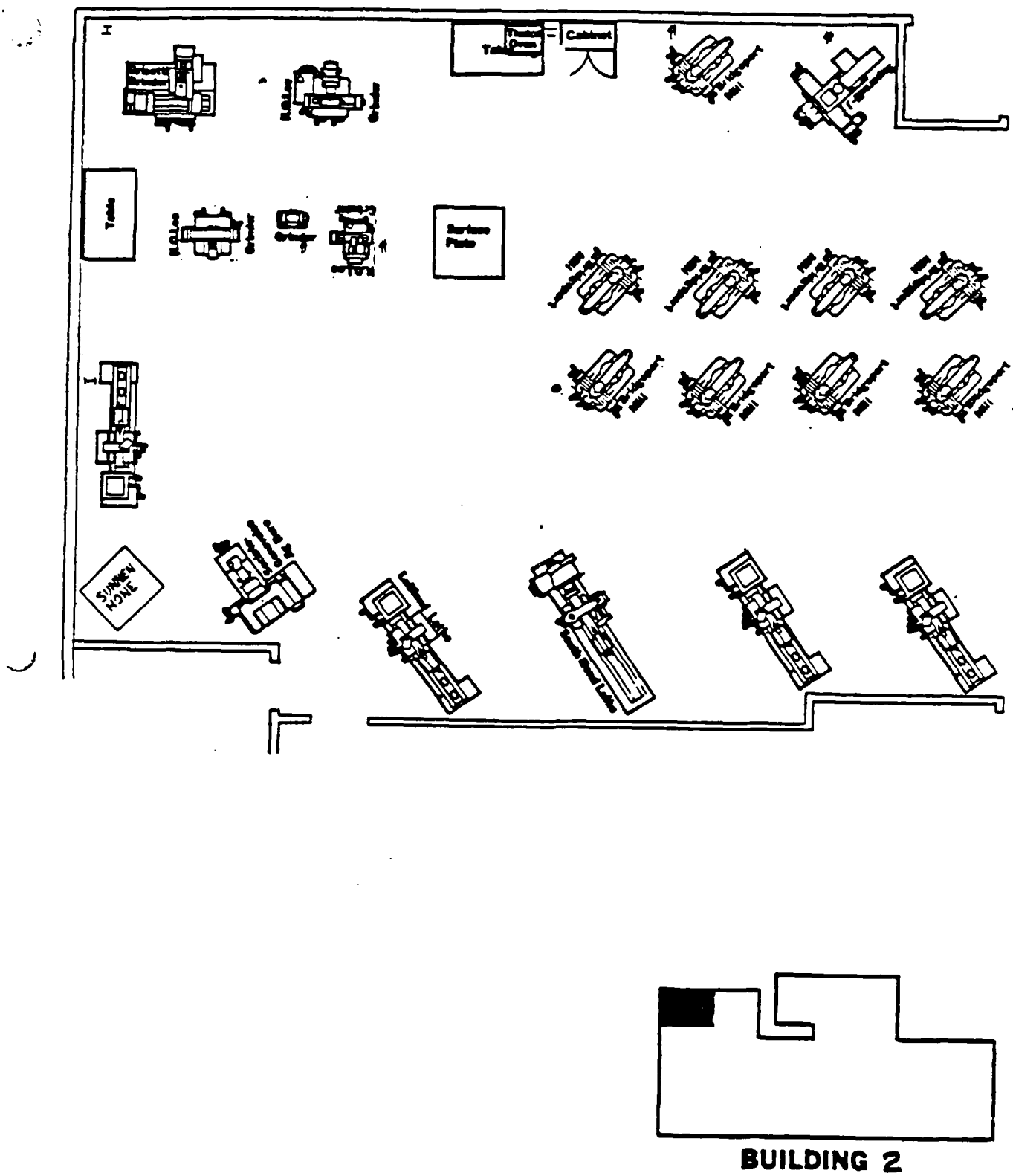


Figure 2-11. IMPROVED TOOL AND MODEL SHOP LAYOUT

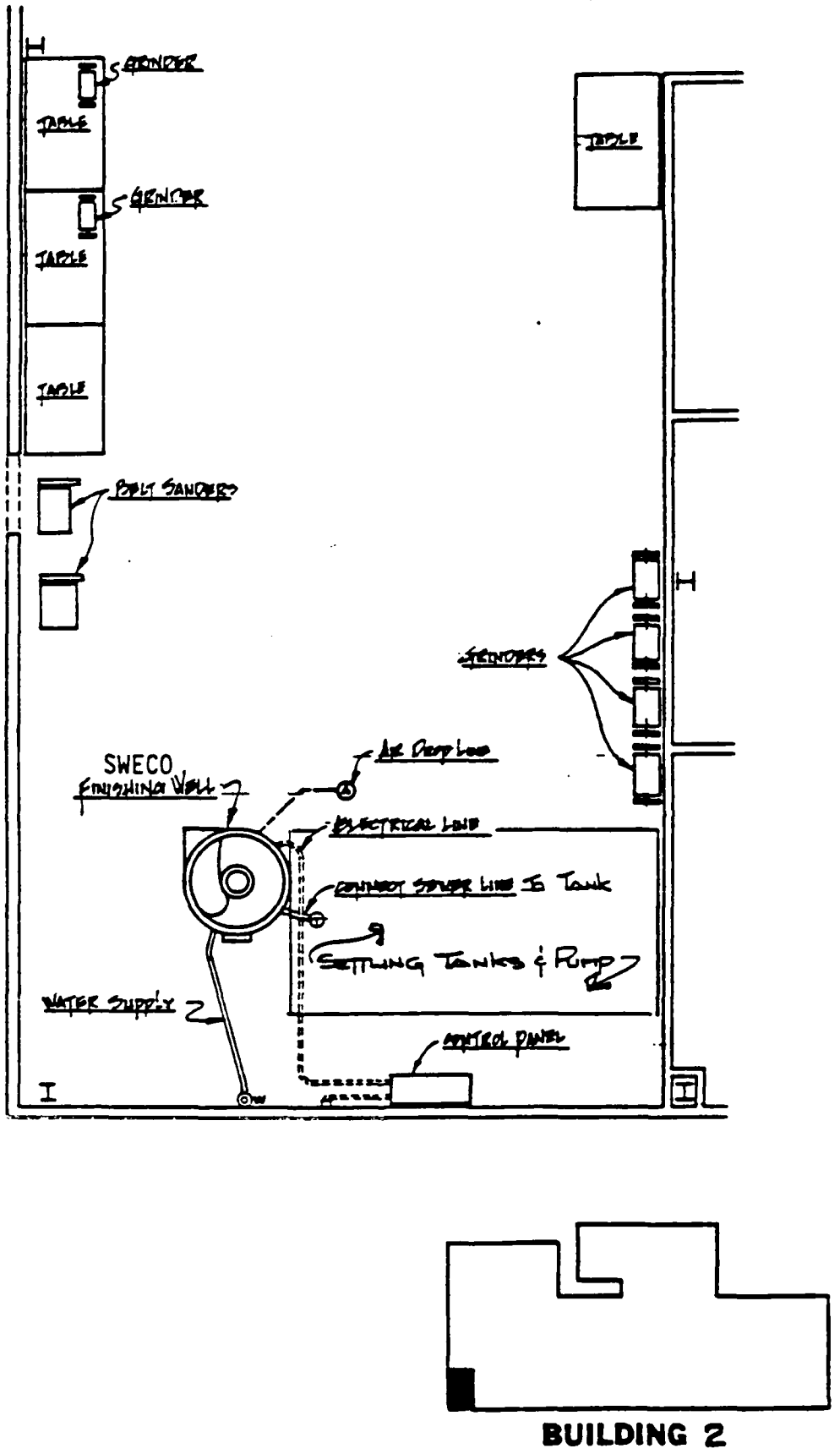


Figure 2-12. NEW DEBURRING WORK CELL LAYOUT

2.1.16 Composite Description of Savings - A composite description of the savings resulting from the improvements in the machine shop project is presented in Figure 2-13.

SUMMARY OF SAVINGS

MACHINE SHOP IMPROVEMENT PROJECT

IMPROVEMENT	NUMBER OF PARTS AFFECTED	AVERAGE LABOR SAVINGS PER PART
CNC Kurakis	45 machined parts	50%
CNC Amada Press Brake	56 sheet metal parts	55%
Arburg Injection Mold	40 molded parts	55%
Helicoil Assembly Tool	19 individual threaded insert part numbers installed in numerous components throughout product lines	70%

Figure 2-13. SUMMARY OF SAVINGS

2.2 Follow-On Machine Shop Improvements

There are other items of capital equipment to be identified by Tracor that will further enhance the productivity of the Machine Shop area. As these items are procured and placed in operation they will be presented as additions to this project and the proposal will be amended accordingly.

2.3 Project Management Plan

The Project Investigator for this project is Pat Casey, Industrial Engineer, although much of the earlier groundwork and coordination on the project was accomplished by Dan Mills who served as Project Investigator during Phase I and Phase II. The Project Investigator reports directly to the Industrial Tech Mod program Manager, who is Russ Petrie. Responsibilities of the Project Investigator include project management, cost, schedule, and technical conformance.

Those departments contributing direct support to the project include Manufacturing Engineering, Quality Engineering, and NC Programming. Considerable overhead support was contributed by Facilities Engineering. The organization for this project is depicted in Figure 2-14. The required job type and manhours for this project appear in Chapter 3. The Project Master Schedule for this project is shown in Figure 2-15.

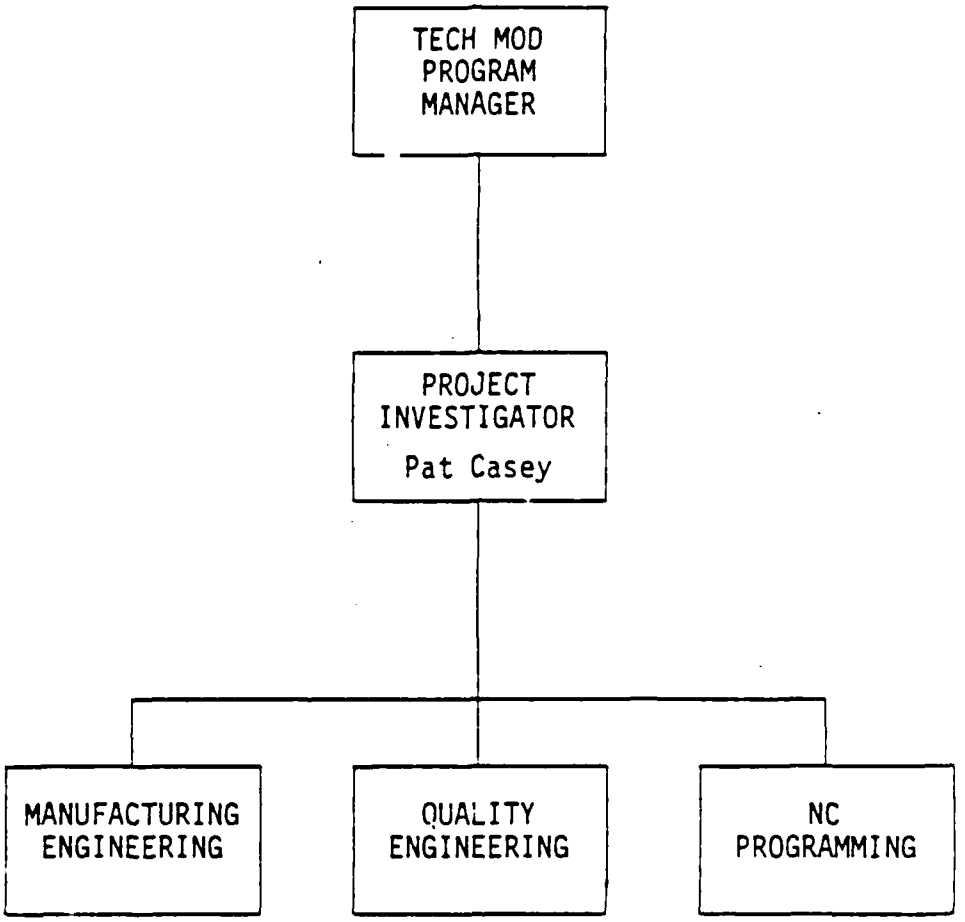


Figure 2-14. ORGANIZATION CHART

Tracor Aerospace

Page 1 of 4

APPROVED BY: R. PETRIE

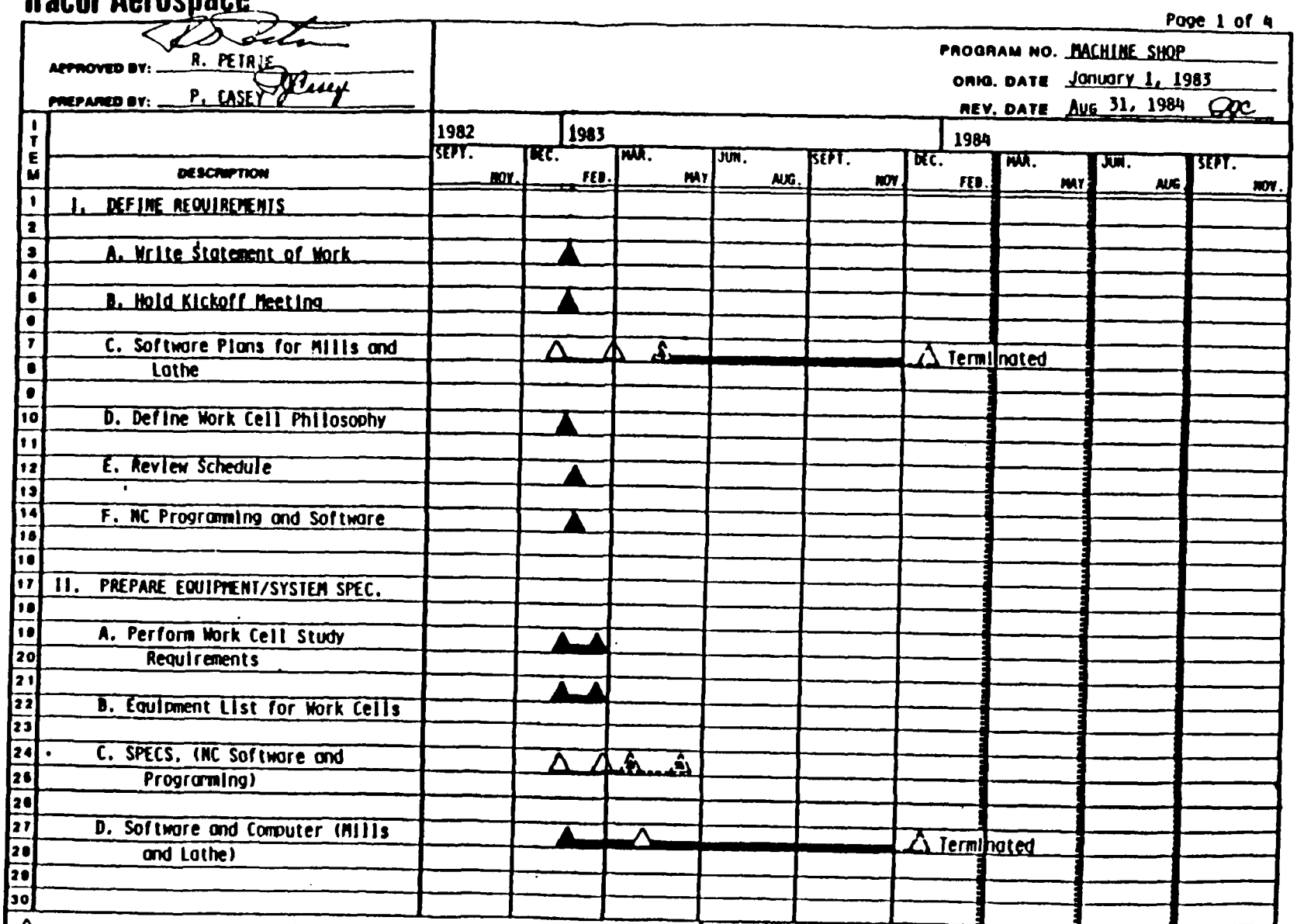
PREPARED BY: P. CASEY

PROGRAM NO. MACHINE SHOP

ORIG. DATE January 1, 1983

REV. DATE Aug 31, 1984 QC

ITEM	DESCRIPTION
1	I. DEFINE REQUIREMENTS
2	
3	A. Write Statement of Work
4	
5	B. Hold Kickoff Meeting
6	
7	C. Software Plans for Mills and
8	Lathe
9	
10	D. Define Work Cell Philosophy
11	
12	E. Review Schedule
13	
14	F. NC Programming and Software
15	
16	
17	II. PREPARE EQUIPMENT/SYSTEM SPEC.
18	
19	A. Perform Work Cell Study
20	Requirements
21	
22	B. Equipment List for Work Cells
23	
24	C. SPECS. (NC Software and
25	Programming)
26	
27	D. Software and Computer (Mills
28	and Lathe)
29	
30	



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▲ COMPLETED ON SCHEDULE

△ - - - △ SCHEDULE COMPLETION EXPECTED TO SLIP

△ COMPLETED AHEAD OF SCHEDULE

△ COMPLETED BEHIND SCHEDULE

▲ △ PROGRESS (IN % COMPLETION)

NOTES

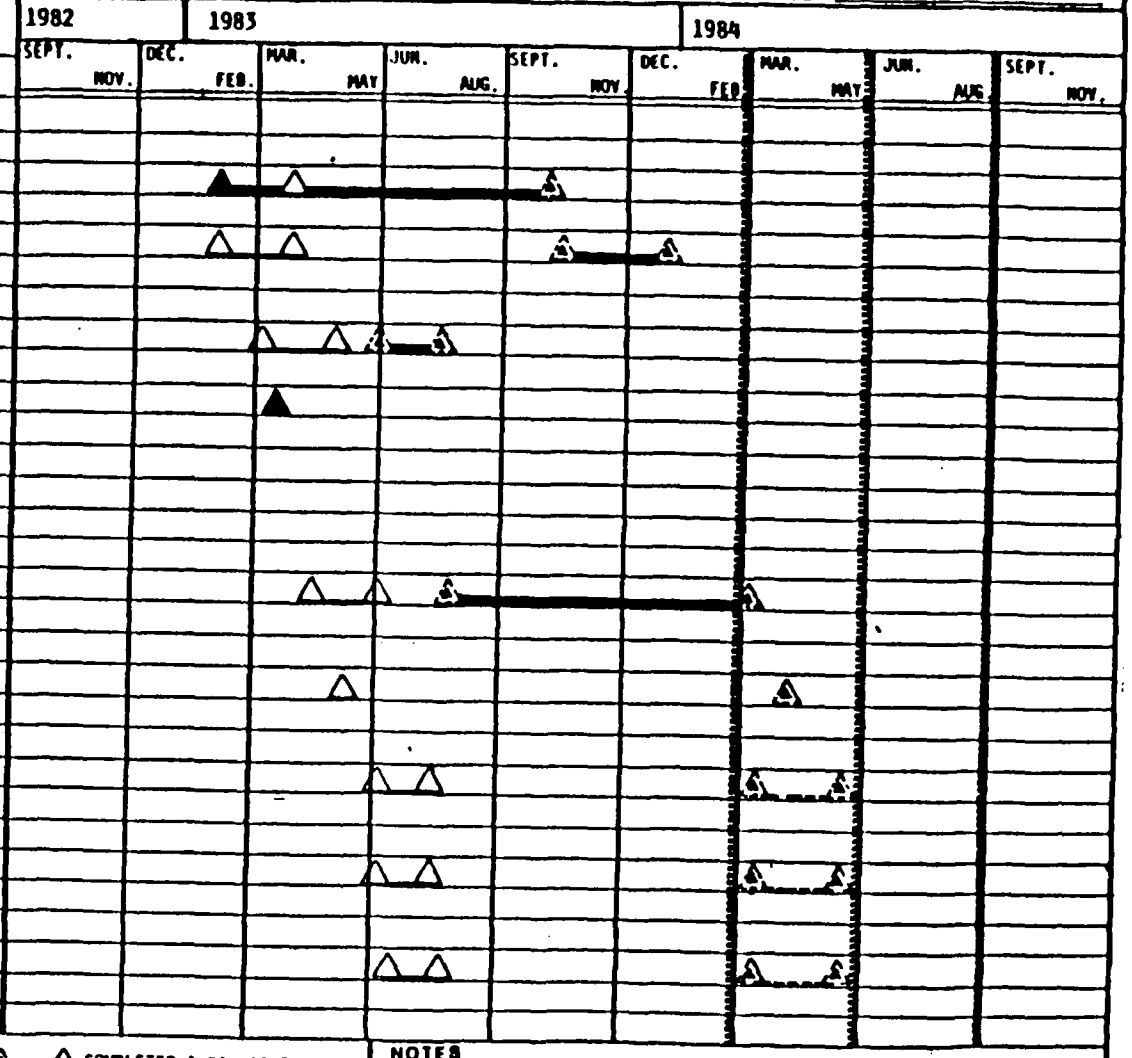
Figure 2-15. PROJECT MASTER SCHEDULE

Tracor Aerospace

APPROVED BY: R. PETRIE
PREPARED BY: P. CASEY

PROGRAM NO. MACHINE SHOP
ORIG. DATE January 1, 1983
REV. DATE Aug 31, 1984

ITEM	DESCRIPTION
1	III. DESIGN SYSTEM/FACILITY
2	
3	A. Shop Layout/Schematics
4	
5	B. Design Material Handling
6	Equipment.
7	
8	C. Select Computer Equipment
9	
10	D. Select NC Software and
11	Programming Equipment
12	
13	
14	IV. COST BENEFIT ANALYSIS
15	
16	A. Establish Cost and Saving
17	Elements
18	
19	B. Approve Contract Delivery
20	Schdeule
21	
22	C. Cost Element Identification/
23	Time Phase
24	
25	D. Savings Elements (LRU/System
26	Hours
27	
28	E. Financial Analysis
29	
30	



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▲ COMPLETED ON SCHEDULE
△ - - - △ SCHEDULE COMPLETION EXPECTED TO SLIP
△ COMPLETED AHEAD OF SCHEDULE
△ COMPLETED BEHIND SCHEDULE
▲ △ PROGRESS (IN % COMPLETION)

NOTES

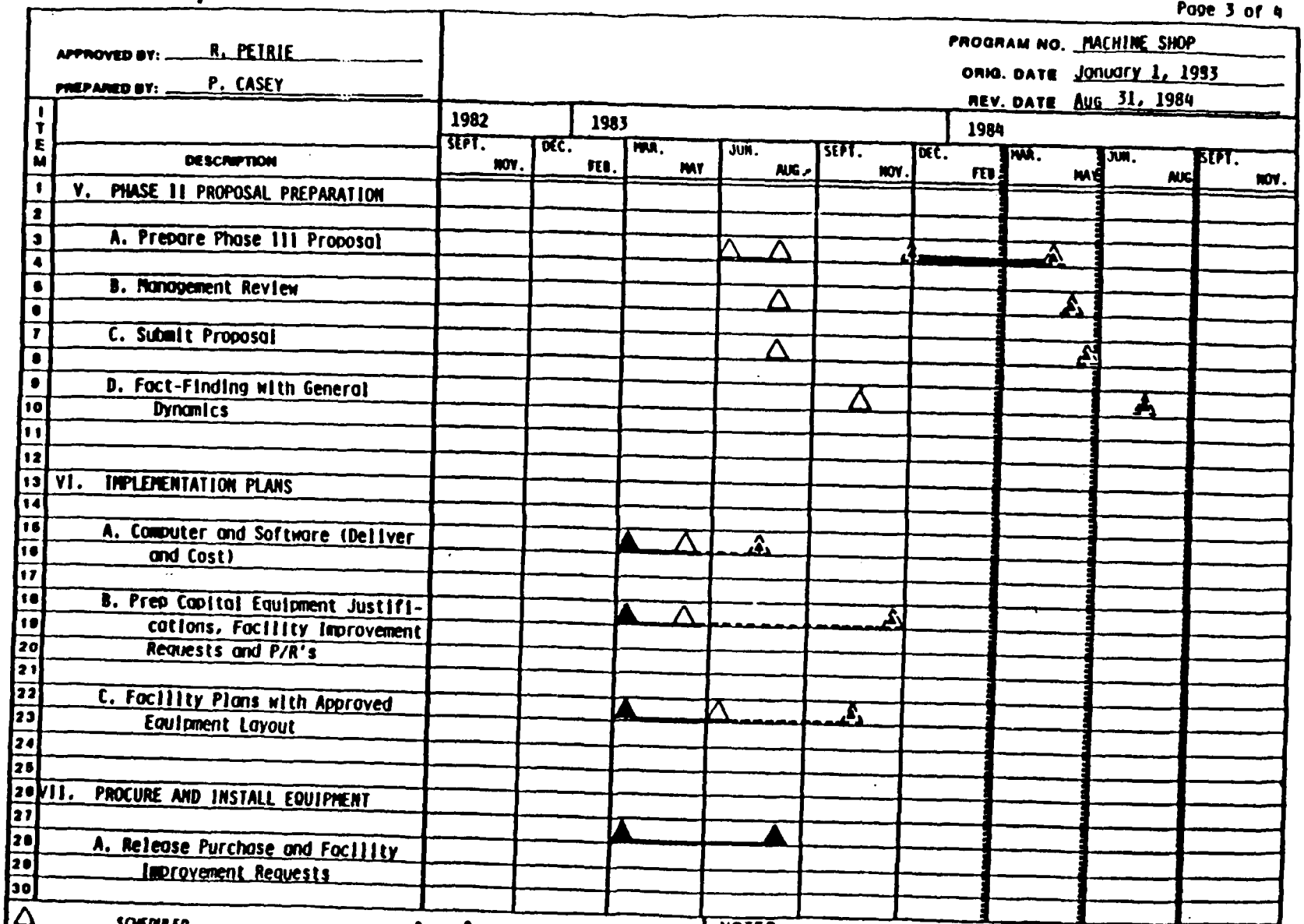
Figure 2-15. PROJECT MASTER SCHEDULE (con't.)

Tracor Aerospace

APPROVED BY: R. PETRIE
PREPARED BY: P. CASEY

PROGRAM NO. MACHINE SHOP
ORIG. DATE January 1, 1983
REV. DATE Aug 31, 1984

ITEM	DESCRIPTION
1	V. PHASE II PROPOSAL PREPARATION
2	
3	A. Prepare Phase III Proposal
4	
5	B. Management Review
6	
7	C. Submit Proposal
8	
9	D. Fact-Finding with General
10	Dynamics
11	
12	
13	VI. IMPLEMENTATION PLANS
14	
15	A. Computer and Software (Deliver
16	and Cost)
17	
18	B. Prep Capital Equipment Justifi-
19	cations, Facility Improvement
20	Requests and P/R's
21	
22	C. Facility Plans with Approved
23	Equipment Layout
24	
25	
26	VII. PROCURE AND INSTALL EQUIPMENT
27	
28	A. Release Purchase and Facility
29	Improvement Requests
30	



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△ COMPLETED AHEAD OF SCHEDULE
△ COMPLETED BEHIND SCHEDULE
▲ △ PROGRESS (IN % COMPLETION)

NOTES

Figure 2-15. PROJECT MASTER SCHEDULE (con't.)

Tracor Aerospace

APPROVED BY: R. PETRIE
PREPARED BY: P. CASEY

PROGRAM NO. MACHINE SHOP
ORIG. DATE January 1, 1983
REV. DATE Aug 31, 1984

ITEM	DESCRIPTION
1	B. Prepare Facility, Move and
2	Install Equipment and Work
3	Cells
4	
5	C. Develop New Methods and Time
6	Standards
7	
8	D. Develop Tooling as Required
9	
10	E. Update PWO's and Instructions
11	
12	F. Debug Equipment
13	
14	G. Personnel Training New
15	Programming Equipment
16	
17	H. Prepare NC Programs and
18	Documents
19	
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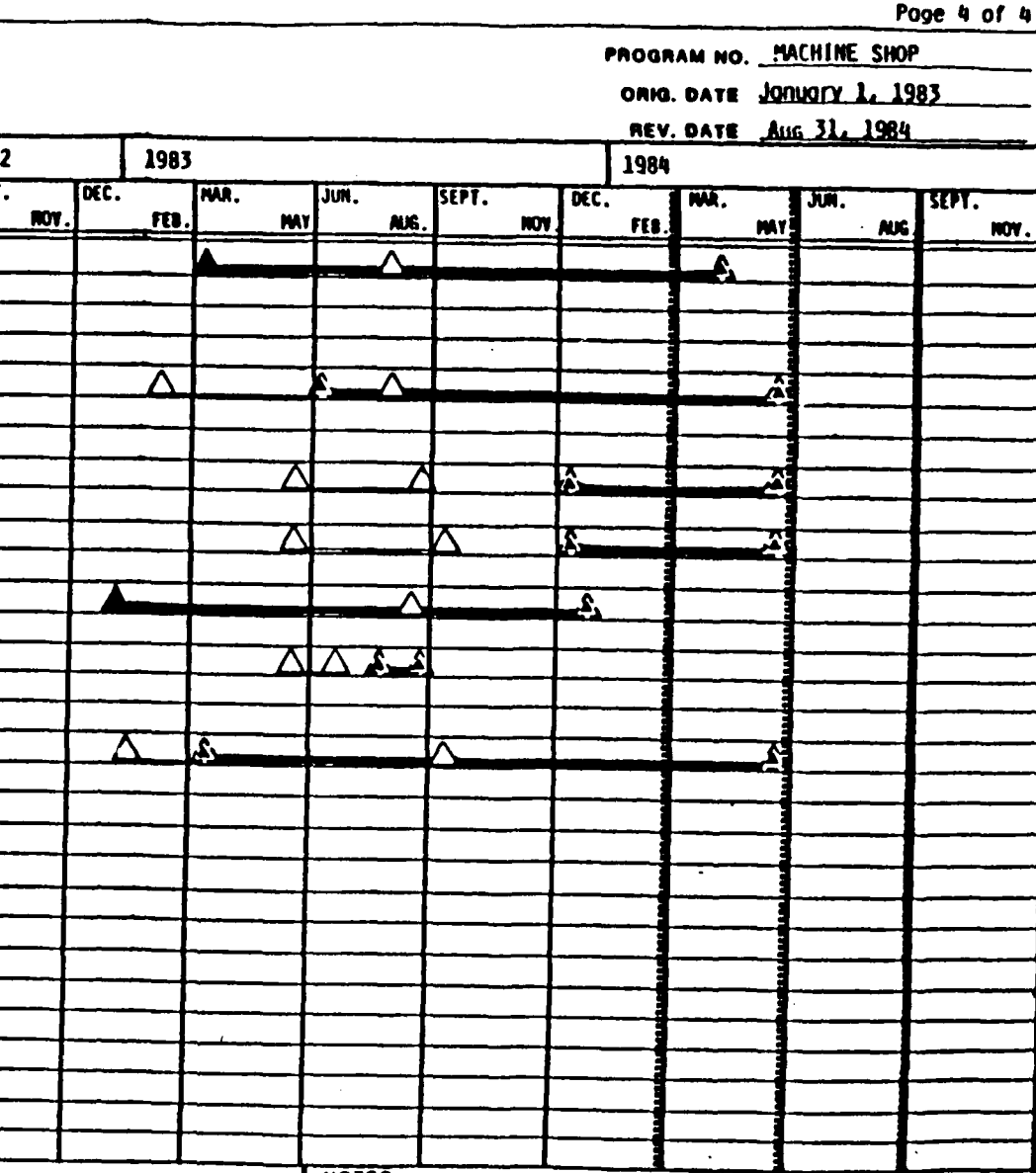

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△ COMPLETED AHEAD OF SCHEDULE
△ COMPLETED BEHIND SCHEDULE
▲ △ PROGRESS (IN % COMPLETION)

NOTES

Figure 2-15. PROJECT MASTER SCHEDULE (con't.)

3.0 COST

The total Tracor investment in the Machine Shop Improvement Project is summarized below:

Category		Reference
Project Expenditure Summary		Figure 3-1
Capital Labor Hours		Figure 3-2
Capital Labor	$ 73,789	Figure 3-3
Capital Material & Other	397,999	Figure 3-4
Expense Investment	84,661	Figure 3-5
TOTAL INVESTMENT	$556,449	

PROJECT EXPENDITURE SUMMARY

COMPANY: Tracor, Inc.

PROJECT: Machine Shop Improvements

CATEGORY	1982	1983	1984	TOTAL
Technology Development (Capital Labor)	$ -0-	$ 44,447	$ 14,956	$ 59,403
Equipment (Capital)	294,027	101,992	-0-	396,019
Software Development (Capital Labor)	-0-	13,496	890	14,386
Other				
Travel (Capital)	-0-	1,980	-0-	1,980
TOTAL (Capital)	$294,027	$161,915	$ 15,846	$471,788
Program Support Labor (Expensed)	$ -0-	$ 23,576	$ 52,972	$ 76,548
Material, FIR's, & Travel (Expensed)	-0-	273	7,840	8,113
TOTAL (Expensed)	$ -0-	$ 23,849	$ 60,812	$ 84,661
GRAND TOTAL INVESTMENT	$294,027	$185,764	$ 76,658	$556,449

Figure 3-1. PROJECT EXPENDITURE SUMMARY

Tracor, Inc.

MACHINE SHOP IMPROVEMENTS PROJECT

Labor Expenditures

(Excluding Contract Labor)

	1983				1984			
	EXP. CODE	AVG. HOURLY WAGE	HOURS CAPITAL	$ CAPITAL ①	EXP. CODE	AVG. HOURLY WAGE	HOURS CAPITAL	$ CAPITAL ②
Project Investigator	05	12.63	1,086.0	35,712	05	15.49		
Mfg. Eng.	05	11.88	73.0	2,267				
NC Programmer	05	10.69	485.0	13,496	05	10.50	32.0	914
Quality Eng.	03	13.40	1.0	29	03	13.71	35.0	1,102
Mfg. Eng. Spt.					05	8.05	299.0	6,544
			1,645.0	$51,504			366.0	$8,560

① Hours x Rate x (1 + overhead). Overhead: Exp. Code 03 = 1.244; Exp. Code 05 = 1.603

② Hours x Rate x (1 + overhead). Overhead: Exp. Code 03 = 1.30; Exp. Code 05 = 1.72

Figure 3-2. CAPITAL LABOR HOURS

Tracor, Inc.
MACHINE SHOP IMPROVEMENT PROJECT
Labor Expenditures (Capital)

	1983	1984	TOTAL
Technology Development			
Project Investigator	$35,712	$ -0-	$35,712
Mfg. Eng.	2,267	6,544	8,811
Quality Eng.	29	1,102	1,131
Contract Labor	6,439	7,286	13,725
	$44,447	$14,932	$59,379
Software Development			
NC Programmer	13,496	914	14,410
TOTAL	$57,943	$15,846	$73,789

- All labor except contract includes total overhead without G&A.

Figure 3-3. CAPITAL LABOR

INDUSTRIAL TECHNOLOGY MODERNIZATION

CAPITAL INVESTMENT

MACHINE SHOP IMPROVEMENTS (MATERIAL AND OTHER)

FACILITY ITEM	P.O./VENDOR	FACILITY VALUE	SCHEDULED ON LINE	ACTUAL ON LINE*
Tombstones (4)	701648/Weatherford	$ 7,252**		
Kuraki Machine Center w/vices (8 ea.)	701647/Japan Machine Tools Corp.	119,549**	3/83	
Kuraki Machine Center w/vices (8 ea.)	701650/Japan Machine Tools Corp.	135,260**	3/83	
Amada Press Brake	701770/U.S. Amada LTD	31,966**	2/83	
Numeridex LC 7000	701925/Numeridex, Inc.	24,450	4/83	
Arburg Injection Mold	701968/Polymer Machinery Corp.	21,085	10/83	
	701969/Master Unit Die Products	1,825		
Gang Drill Automation	701965/Rex Supply	11,611	8/83	
	701966/Rex Supply	6,631		
Helicoil Assembly Tool	702106/Hardware Metals Industries	625	10/83	
Tool Storage Cabinets	702116/P.D. Browne Co.	10,912	2/84	
Electronic Counting Scale	701920/Abbott Scales	1,300	5/83	
Forklift Service	830848/Austin Rigging	750	3/83	
FIR's	Various Suppliers	5,365	10/83-4/84	
Total Material		$378,581		
Tax (5% of all above except **)		4,228		
Material Handling		13,210		
Material Loaded		$396,019		
Travel		1,980		
TOTAL		$397,999		

* Actual on-line date will be completed by General Dynamics.

** Includes Taxes/Material Handling.

Figure 3-4. CAPITAL MATERIAL AND OTHER

TRACOR, INC.

MACHINE SHOP IMPROVEMENTS PROJECT

EXPENSE CHARGES (LOADED)

	1983		1984		Total	
	Hrs	$'s	Hrs	$'s	Hrs	$'s
Program Support Labor	1,416.0	23,576	2,716.0	52,972 ①	4,132.0	76,548
Material	-0-	32	-0-	468	-0-	500
Travel	-0-	241	-0-	94	-0-	335
FIR's	-0-	-0-	-0-	7,278 ②	-0-	7,278
Total Investment	1,416.0	23,849	2,716.0	60,812	4,132.0	84,661
Less:						
Recovered ③	862.3	14,524	559.0	15,333	1,421.3	29,857
Non-Recovered	553.7	9,325	2,157.0	45,479	2,710.7	54,804

① $17,899 budgeted

② $7,278 budgeted

③ After applying 60.9% as percent DoD business to budget or pre-'84 figures

Figure 3-5. EXPENSE INVESTMENT

4.0 SAVINGS

A computer program was written to calculate the savings on the Machine Shop Improvement project. This was necessary due to the otherwise time-comsuming task of screening all Tracor LRU's (Line Replaceable Units) for the 160 different parts being run on the Kurakis, Amada, etc.

The decision to calculate savings by computer was strongly influenced by the fact that all Tracor LRU's are loaded and maintained in the computer with a complete listing of the part numbers contained in each LRU. By creating four (4) separate files showing part numbers and time saved per part for those parts run on the Kurakis, Amada Press Brake, Arburg Mold Press and Helicoil Assembly tool, the computer could be programmed to screen all LRU's for those parts and print out the results. Once that was done it was a simple matter for the computer to calculate the savings based on the current shop rate, and the LRU build schedule.

4.1 Inputs

The inputs to the computer program were as follows:

- 135 LRU numbers encompassing Countermeasures, Telecommunications, and Digital and Applied Systems
- 45 Kuraki part numbers and time saved/part
- 56 Amada part numbers and time saved/part
- 40 Arburg part numbers and time saved/part
- 19 Helicoil part numbers and time saved/part
- Shop rates ($ per hour) both loaded and unloaded for 1983-1993, based on the current bid package
- Firm build schedules, 1983-1993, by LRU (broken out separately for F-16, other USAF, other DoD, and Commercial)
- Projected build schedules, 1984-1993, by LRU (broken out separately for F-16, other USAF, other DoD, and Commercial)

4.2 Outputs

The computer was programmed to produce a variety of reports including:

- LRU's containing any of the Amada parts and quantity
- LRU's containing any of the Arburg parts and quantity
- LRU's containing any of the Helicoil parts and quantity
- LRU's containing any of the Kuraki parts and quantity
- F16 savings by LRU, by year (Firm, Proposed, Loaded, Unloaded)
- Other USAF savings by LRU, by year (Firm, Proposed, Loaded, Unloaded)
- Other DoD savings by LRU, by year (Firm, Proposed, Loaded, Unloaded)
- Commercial savings by LRU, by year (Firm, Proposed, Loaded, Unloaded)

4.3 Break-in Point

Shown below are the effective dates of the various Machine Shop Improvements:

CNC Kuraki Horizontal Milling Machines	1 April 1983
CNC Amada Press Brake	1 April 1983
Arburg Injection Mold Press	1 January 1984
Helicoil Assembly Tool	1 January 1985

4.4 Total Savings

Figure 4-1 shows the total savings resulting from the Machine Shop Improvements Project for the years 1983 through 1993. The savings are broken out by category (F-16, other USAF, other DoD and Commercial) for both firm and projected build schedules. The savings reflect loaded shop rates but do not include profit or CAS 414 (Cost of Money) Factors.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
Instant												
F-16	5,787	7,974	1,730	763								16,254
USAF	100,597	167,490	19,179									287,266
DoD	584	818	63									1,465
COML	12,030	48,231	296									60,557
Total	118,998	224,513	21,268	763								365,542
Follow-On												
F-16			6,908	843	2,657	2,790	2,932	968	98			17,196
USAF		22,646	99,661	81,563	92,753	84,970	72,021	25,912	4,517			484,043
DoD		1,081	880	13,203	30,388	21,772	14,238	8,185	750			90,497
COML		17,103	37,163	36,808	22,018	27,931	41,366	6,030	2,618			191,037
Total		40,830	144,612	132,417	147,816	137,463	130,557	41,095	7,981			782,771
GRAND TOTAL	118,998	265,343	165,880	133,180	147,816	137,463	130,557	41,095	7,981			1,148,313

Figure 4-1.

MACHINE SHOP SAVINGS BY YEAR IN LOADED DOLLARS,
USING INSTANT AND FOLLOW-ON BUILD SCHEDULES, AND
FOUR CUSTOMER CATEGORIES
(NOTE: PROFIT AND CAS 414 FACTORS NOT INCLUDED)

4.5 Shop Rates

Figure 4-2 shows the shop rates that were used in the savings calculations for each shop. Shown below are the 1984 basic hourly rates for these shops and the percent supervision:

Machine	Shop	Hourly Rate	Percent Supervise	Supervisory Hourly Rate
Kuraki	Machine Shop	$ 9.18	3.2%	$11.98
Amada	Sheet Metal	7.69	5.0%	11.98
Arburg	Mold Shop	11.39	4.5%	11.98
Helicoil	Sheet Metal	7.69	5.0%	11.98
3% & Misc.	Combined	8.61	-0-	11.98

Example: 1984 Kuraki Shop Rate (Machine Shop)

$$\frac{(\text{Hourly Rate}) + (\%\ \text{Supervision})(\text{Supv. Hourly Rate})}{(1 + \text{Supv. }\%)} \times (1 + \text{PSI}) =$$

$$\frac{9.18 + (.032)(11.98)}{(1 + .032)} \times 1.0041 = \$9.30 \text{ (Adjusted for supervision)}$$

$$(\text{Adjusted Rate}) \times (1 + \text{Mfg. OH}) \times (1 + \text{G\&A}) = \text{Loaded Shop Rate}$$

$$\$9.30 \times (1 + 1.60) \times (1 + .161) = \$28.07$$

SHOP SAVINGS	1983	1984	1985	1986	1987	1988	1989	1990	1991
Kuraki	26.33	28.07*	29.11	29.93	31.43	33.01	34.65	36.38	38.19
Amada & Helicoil	22.76	23.93	24.77	25.50	26.76	28.11	29.52	30.98	32.54
Arburg	---	34.61	35.87	36.91	38.75	40.69	42.74	44.85	47.11
Includes:									
MFG O/H	1.595	1.60	1.59	1.525	1.525	1.525	1.525	1.525	1.525
G&A**	.161	.161	.155	.161	.161	.161	.161	.161	.161
PSI***	1.000	1.0041	1.05	1.1025	1.1576	1.2155	1.2763	1.3401	1.4071

* Calculation explained on Page 62.

** G&A: General and Administrative.

*** PSI: Projected Salary Increases.

NOTE: 1983 rate based on year-end 1983 rates.
1984-1991 hourly rates based on 3rd quarter bid package 1984.
1984-1991 overhead rates based on 4th quarter bid package dated 11-1-84.

Figure 4-2. SHOP RATES (IN DOLLARS)

5.0 IRR METHOD

IRR DATA

1. **Depreciation Mechod** Accelerated Cost Recovery System (ACRS) which depreciates equipment over an average life of 5 years.

2. **Income Tax Rate** Corporate tax rate of 46% used to calculate after tax figures.

3. **Insurance Costs** Included in overhead calculation as a part of burden expenses.

4. **Investment Tax Credit** Ten percent investment tax credit rate used on all capital investment numbers of current and out years.

5. **Profit Rate** 15%

6. **Average IRR Over the Last Five (5) Years** 20%

7. **Present Corporate Guidelines on IRR** Corporate IRR is no less than 20%.

8. **Direct Labor Rate Projections through FY 93** Direct labor rates by job code computed by averaging all the salaries for each job code that is in effect at the end of the most currently completed quarter. These rates reflect average pay data as of July 28, 1984. The labor escalation factor applied by Aerospace is called PSI. It is applied by job function by month. The labor escalation factor used is as follows: 1984-1993 - 5.0%.

9. **Other** Discount rate of 12% was used in all present value calculations.

INDUSTRIAL TECHNOLOGY MODERNIZATION INTERNAL RATE OF RETURN

PROJECT: MACHINE SHOP IMPROVEMENTS

IRR %: 23.31

CATEGORY: I

PAYBACK PERIOD: 2 years 6 months

	CAPITAL INVESTMENT	NON-CAPITAL INVESTMENT	TOTAL INVESTMENT	TOTAL SAVINGS (1)	SUBCONTRACTOR SHARE OF SAVINGS	DEPRECIATION (TAX)	COST OF MONEY RECOVERY	TOTAL CASH FLOW BEFORE TAX	TOTAL CASH FLOW AFTER TAX	INVESTMENT TAX CREDIT	SUBCONT. SHARE OF NET CASH FLOW AFTER TAX	DISCOUNTED CASH FLOW AFTER TAX 12%
1982	$294,027	$ -0-	$294,027	$ -0-	$ -0-	$ 41,899	$ -0-	$ 61,634	$ 75,835	$ 29,403	$ 75,835	$<226,317>
1983	161,915	23,849	185,764	145,602	130,878	84,525	26,697	222,430	197,243	16,192	197,243	<234,937>
1984	15,846	60,812	76,658	328,437	247,544	94,757	20,190	296,059	239,556	1,585	239,556	<125,537>
1985				204,473	145,164	94,272	15,905	238,247	200,110		192,952	<2,913>
1986				163,895	106,827	94,122	6,233	185,862	171,684		165,330	90,900
1987				181,894	123,836	35,463	<2,093>	182,530	125,438		108,720	145,981
1988				169,151	-0-	3,161	<3,545>	142,584	79,391		6,612	148,972
1989				160,651	-0-		<3,240>	115,633	62,442		3,183	150,257
1990				50,568	-0-		3,019	49,040	26,481		3,183	151,405
1991				9,828	-0-		5,335	12,499	6,749		3,183	152,429
1992							5,894	5,894	3,183		3,183	153,344
1993							5,894	5,894	3,183		3,183	154,161
Total	471,788	84,661	556,449	1,414,498	754,249	448,199	80,289	1,518,304	1,191,293	47,180	1,002,163	154,161

(1) Savings include profit and CAS 414 factors

Figure 5-1. INTERNAL RATE OF RETURN

6.0 PROPOSED SHARING ARRANGEMENT

SAVINGS		REFERENCE
Subcontractor Share	$1,064,253	Figure 6-2
DoD Share	350,245	Figure 6-2
TOTAL	$1,414,498	

Figure 6-1. SAVINGS SHARE

Subcontractor Share	Share	%	Total
Commercial Savings	$ 310,003	100%	$ 310,003
Instant F-16 Savings	19,870	100%	19,870
Follow-On F-16 Savings	10,903	51.9%	20,994
Instant Other DoD Savings	355,973	100%	355,973
Follow-On Other DoD Savings	367,504	51.9%	707,658
TOTAL	$1,064,253		$1,414,498

DoD Share	Share	%	Total
Commercial Savings	$ -0-	-0-	$ 310,003
Instant F-16 Savings	-0-	-0-	19,870
Follow-On F-16 Savings	10,091	48.1%	20,994
Instant Other DoD Savings	-0-	-0-	355,973
Follow-On Other DoD Savings	340,154	48.1%	707,658
TOTAL	$ 350,245		$1,414,498

* All computations include profit & CAS 414 factors.

Figure 6-2. SAVINGS SHARE DETAIL

Savings	1984 - 1991	
IRR (after tax)	23.31%	
Total Savings		$ 1,414,498*
Instant - DoD		$ 375,843
Commercial Savings		$ 310,003
DoD Share		$ 350,245
Net Savings		$ 378,407
DoD Business Base 1985-87		$148,850,000 (Cost w/o G&A)

Factor: .002542 Applied to Cost thru G&A

* Dollars include profit.

Figure 6-3. VENDOR FACTOR COMPUTATION